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SIXTIETH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

TWENTY-FIFTH ANNUAL REPORT OF THE MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION.

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TABLE OF CONTENTS.

State Board of Agriculture, 1913.

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His Honor DAVID I. WALSH.

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J. LEWIS ELLSWORTH, *Secretary of the Board to July 1.*

WILFRID WHEELER, *Secretary of the Board after July 1.*

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HENRY M. HOWARD of West Newton,	1915
CHARLES M. GARDNER of Westfield,	1916

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Housatonic,	R. H. RACE of North Egremont,	1915
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Marshfield (Agricultural and Hort'l),	WALTER H. FAUNCE of Kingston,	1915
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1916
Massachusetts Horticultural,	WILFRID WHEELER of Concord,	1915
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1915
Middlesex North,	GEO. W. TRULL of Tewksbury (P. O. Lowell, R. F. D.),	1914
Middlesex South,	JOHN J. ERWIN of Wayland,	1914
Nantucket,	HERBERT G. WORTH of Nantucket,	1915
Oxford,	WALTER A. LOVETT of Oxford,	1916
Plymouth County,	AUGUSTUS PRATT of Middleborough (P. O. North Middleborough),	1914
Quannapowitt,	CALVERT H. PLAYDON, D.V.S., of Reading,	1916
Spencer (Farmers' and Mechanics' Association),	EDWARD WARREN of Leicester,	1916
Union (Agricultural and Hort'l),	HENRY K. HERRICK of Blandford,	1916
Weymouth (Agricult'l and Indust'l),	THERON L. TIRRELL of Weymouth (P. O. South Weymouth),	1915
Worcester,	B. W. POTTER of Worcester,	1914
Worcester East,	GEO. F. MORSE of Lancaster,	1915
Worcester North (Agricultural and Driving Association),	L. E. FLETCHER of Fitchburg,	1915
Worcester Northwest (Agricultural and Mechanical),	ALBERT ELLSWORTH of Athol,	1916
Worcester South,	WILLIAM E. PATRICK of Warren,	1916
Worcester County West,	JOHN L. SMITH of Barre,	1914

The Commonwealth of Massachusetts.

THE SIXTIETH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

As the year of 1912 draws to a close, your attention should be called to the manifold signs of progress in rural thought and activity throughout the Commonwealth. The significant fact that the ever-widening wave of interest in things agricultural on the part of the city dweller and the amateur agriculturist, as well as among the rank and file of our farmers, has continued to spread and enlarge and to engulf a larger and still larger proportion of the population of the Commonwealth, is forcibly impressed upon your secretary. Herein, perhaps, lies one of the most important phases of the work of the State Board of Agriculture, — and of all organizations whose aim it is to benefit the people of the State, — the redirecting of thought and action into agricultural channels, that the hills and valleys of the Old Bay State may be repopulated; that the land may be tilled to a greater extent and with a greater efficiency; and that those crowded dwellers of our cities and manufacturing towns who feel the call of agriculture, and are willing and able to take up the business of farming in the accepted modern and businesslike manner, may avail themselves of the opportunity. Such an awakening is now being experienced. Starting several

years ago, it has shown a constant and almost amazing progress, and this year has seen no relaxation of interest. One factor, however, — and the one which is, perhaps, the greatest check to this movement, — is the inability of the would-be farmer to secure funds, either for buying or for stocking a farm after it is purchased. Very few of the great working class, which forms such a vital part of our whole population, are able to accumulate sufficient funds to enable them to establish themselves on the land. Were there funds made available in the shape of bonds issued by the State, procurable at a reasonable rate of interest, and available to farmers and those who desired to become farmers, the greatest hindrance in this work of assisting those who have the desire and ability for the calling of agriculture would be overcome.

The interest in agriculture of the capitalist, or, perhaps we may better say, the interest of the man with money to invest, which was mentioned in the last annual report, has not only continued, but has greatly increased. The recent exhibitions of what Massachusetts and New England can produce in fruit and other produce have caused the scales to fall from the eyes of those who have seen only the possibilities of the west, and who have been blind to the greater opportunities lying beneath their hand and in close proximity to the best markets of the world. With these demonstrations of what can be done in a commercial way before them, these men are casting about for suitable locations for investing their money, not for pleasure, not as a toy, but as a real business venture.

The study and research for the improvement of agriculture, to which we are so greatly indebted for the wonderful progress of the past several years, has been taken up in the only logical way. The first step was the study of the soil itself in connection with the crop to be grown. The enemies and diseases to which the crop was subject were then taken up, and their subjection and control was accomplished so far as possible. Attention has more lately been given to the preparation of the product for the market, and great efforts have been made to secure the adoption of the most approved methods now known. Now comes, then, the next step, the solution of the marketing problem itself. The selling of the product, the

final step, is indeed one of the most important of all. How shall the product be placed in the hands of the consumer in the best possible condition? How can this be done with the least expense? How can the producer secure the very largest possible share of the consumer's dollar? How can he secure the portion of that dollar which is just and proportionate to the importance of his part in making available to the consumer the various products of the soil? These are some of the problems which now present themselves in this connection, and which are now receiving the attention of progressive farmers and those others who are directly interested in the promotion of our agriculture, among whom the State Board is by no means least. A committee of this Board now has this matter under consideration and will report at this meeting. The advent of the parcel post, limited though it may be, it is hoped may help to solve some of these problems, may narrow the gulf between producer and consumer, at least in so far as the ratio of amount received to price paid is concerned. The solution of the problem of marketing lies in earnest study and practical application. These factors are now being brought to bear, and with the solution of this problem, which must shortly come to a realization, we can be assured of a continuance of the remarkable progress of the farmer, and of agriculture as a whole, which has characterized the past decade.

Turning to a consideration of the season, — the weather and its general effect on crop production, — and of the progress and results of the work, we find that, in general, conditions have been very satisfactory. While crops, as a whole, and for the country as a unit, have been excellent when compared with some of the yields of recent years, the figures from this State show that, in general, Massachusetts crops have been a very good average. The month of May was exceedingly cold and wet, and at the end of the month the season was from ten days to two weeks late. Although this was bad for market-garden and farm crops, it was, on the other hand, a wonderful help to grass lands and pastures. After the successive and severe droughts of the past several years this was the one and only thing that could put the sward into such a condition as to enable it to produce a satisfactory crop. Conditions changed, however,

and scarcely any rain fell from the 1st of June until late in July. Thus, what promised to be an excellent hay crop proved to be a trifle below the normal, although somewhat better than for several years. On high, ordinarily dry land, early planted crops germinated well, but owing to the lateness of the season and to scarcity of help, planting in general was very much behind. The drought of the early summer also set back the crops to some extent. The value of the use of the summer silo, supplementing the shortage in the pastures, was again strikingly illustrated, and attention was directed to this important adjunct to the dairy industry by an article in the July Crop Report by one of New England's most successful and most practical dairymen. Farmers, however, were much more fortunate than in 1911, in that the lateness of the spring was largely offset by a corresponding lateness in the fall, the month of September being unusually favorable to the development of the backward crops. While there were neither late frosts in the spring nor early frosts in the fall to do serious damage, it is worthy of note that not a month passed during the year which was not accompanied by light, but more or less general, frosts.

The season of 1912 as a whole can be considered as a fairly profitable one, although the scarcity and high price of help, low prices for certain products, excessive cost of repairs to tools and buildings, high prices of grain and feeds and the high cost of the necessities of life were all factors in reducing materially the profits which might have been realized in the absence of these drawbacks.

The apple crop was somewhat below the average in quantity, but in quality it was excellent. The results of the educational exhibits and demonstrations, conducted by this Board and other organizations, are very gratifying in the larger application of modern accepted methods of producing and marketing this fruit. This points the way to the supplanting of western fruit in our New England markets by the choicer native products grown in close proximity to our wonderful markets by the farmers and fruit growers of Massachusetts and neighboring States.

Market gardeners did fairly well, although early potatoes were nearly a failure, and onions were very low in price. Late

crops were favored with more congenial conditions than the early ones.

Tobacco was fully up to the average in both quantity and quality, and a slight increase in acreage is indicated. The cranberry crop was not especially good, owing to frost and worm damage combined. The poultrymen in the State are quite optimistic and in general have had a very satisfactory season, despite the high prices of grain and feeds. Prices for all farm products for the year ruled about an average, with a slight tendency upward, which, however, was more than offset by the increased cost of materials which the farmer must purchase.

Roads.

The State of Massachusetts ranks far ahead of most other States in the percentage of "improved" roads to total mileage of all roads. This means that the State realizes the value and the importance of good roads. But there is one feature that should be brought to your attention. While we have many miles of macadam or so-called "State road," the majority of our country roads are unimproved. The main arteries of travel, the through highways, are the ones which have been improved; and they should be. But at the same time the result of this improvement is an unjust tax for their construction and their maintenance upon the farmer. Not only must he pay his proportionate tax upon the improved highways, when in the majority of instances he receives but little, if any, benefit from them, but he must also meet that very present assessment of wear and tear on equipment which poor roads entail. The constant and increasing use of the automobile on the town roads, necessitating a larger outlay for their maintenance, is the source of further hardship to the farmer. Your secretary suggests, for the relief of this situation, that the tax on automobiles be increased, and that this additional revenue be put at the disposal of the towns which would be willing to co-operate in the matter of road improvement, in addition to what is already available from the State. This method, coupled with the continued policy of road improvement throughout the Commonwealth, will in time remedy the present unjust situation. Good roads mean much for the country, larger profits for the

farmer, closer communication with sources of supply and distribution centers, and a larger, fuller life for the individual and the community.

Dairying and Sheep Raising.

As we turn to the business of dairying, present conditions forcibly impress upon your secretary the fact that the placing of this industry on a basis which will be financially profitable to the producer is the problem of the hour. This is fundamental and must be accomplished if the industry itself is to be preserved. In this connection emphasis should be laid upon the necessity of a discrimination on the part of the public in favor of near-by Massachusetts milk of excellent quality and cleanliness, rather than the milk from neighboring States, of less certain quality and of necessity older, owing to distance of shipment. A valuable and practical suggestion is the labeling of milk produced in Massachusetts. This, coupled with the education of the consumer to the real value of milk, which is being promoted by this Board, should greatly aid the situation. Another point; the dairyman should raise his own cows. The heaviest cost in raising a cow is during the first three months. Pasturage is cheap, and upon reaching the age of from two years to thirty months, they should freshen, and thereafter pay their way. And in this connection your secretary would urge upon the dairymen the value and practicability of the "neighborhood sire," the co-operative purchase and use of a pure-bred animal of good descent. In view of the recognized fact that the sire is half of the herd, and that the majority of our dairymen have not the necessary capital to purchase such an animal as would meet the requirements, this is a most feasible solution. At the present time beef is higher than it has been at any time since the civil war. With this fact in mind the advantages of raising stock are even greater than otherwise, as the dairyman can in no way suffer loss, as, should an animal prove for any reason unfit for the dairy herd, there is a profit to be received from its sale as beef. Adverse as are conditions for dairying in this State at the present time, strict as the laws and regulations for the production of milk have been made, the dairyman should avail himself of these opportunities

to increase the profits which present conditions are doing so much to reduce.

Sheep raising, with the present high prices of both meat and wool, should also receive more attention. The one great obstacle to the sheep industry is the ravages of dogs. The decline of sheep raising is graphically shown by the following figures, giving the number of sheep in Massachusetts at different periods since 1860: —

	Sheep.
1860,	114,829
1885,	55,140
1910,	32,708
1912,	24,551

These figures show a decrease of practically 72 per cent. in the number of sheep in the State during a period of fifty years.

In order that the sheep industry might be properly redeveloped, the proposition of a substantial increase in the amount of our dog license should be considered, to include all breeds which are a menace to this industry. Sheep should roam our fields and hills instead of the wild deer which are now so plentiful, and which each year exact such a toll from our agriculture, a toll which is not, nor can be, returned to the farmers by the State.

Waste Lands.

Your secretary at this time would again call attention to the advisability of developing our waste lands — swamps — which, by drainage projects could be made available to agriculture. This matter was brought to the attention of the Board at the business meeting in June, and strong emphasis should be laid upon it. While the more adequate tillage of the acres now under cultivation, rural credit, the conditions in the dairy industry and the adequate marketing of products should first receive attention and correction, still, this subject of reclaiming our present idle lands should be actively considered. The situation is peculiarly a State problem, as there are many tracts of valuable land, generally extending over a number of adjoining farms and often running over into different townships,

which might be made available by drainage. The solution of the problem is not within the reach of the individual land-owner or town authority, but must be undertaken by the State. There is no means of ascertaining the exact amount of land which could be made available to agriculture by such drainage, but the amount of this land is surprisingly large, and I bespeak your earnest consideration of this matter, and would suggest that the Board declare itself in favor of the general scheme of such reclamation, and that its committee appear in favor of any measure which will result in thus materially increasing the agricultural wealth of the State.

Legislation of 1912.

It was felt that the several recommendations of this Board received fairly liberal treatment by the Legislature of 1912. The appropriation for the dissemination of useful information in agriculture was increased from $5,000 to $6,000, in accordance with the enlarged demand for such information. The amount of bounty available to the several agricultural societies represented on the Board was increased by $400 for each society, $200 to be used for general awards and $200 for the encouragement of agricultural thought and activity among children and youths. In recognition of the most valuable work of the State Ornithologist, a bill to increase the appropriation for the salary of this official from $500 to $2,000 was introduced, and finally became a law after the amount had been reduced to $1,500. An increase of the annual appropriation for nursery inspection from $12,000 to $15,000 was granted. An annual appropriation of $2,000 for the encouragement of agriculture by holding of special exhibitions was granted. A bill carrying an appropriation of $2,000 for the purpose of making an exhibit at the American Land and Irrigation Exposition in New York was passed. A bill to provide for the encouragement of our declining dairy industry failed of enactment, as did also a provision for the publication of a farm catalogue; and a bill providing for the further consolidation of the State work for agriculture, by bringing the work of the Cattle Bureau under the direction of this Board, received unfavorable action by the Legislature.

Milk Legislation of 1912.

An act relative to the labeling of containers of condensed, concentrated and evaporated milk and skimmed milk, and an act to regulate the use of utensils for testing the composition or value of milk and cream, were the only laws relating to the dairy industry passed in 1912. The former perfects the labeling act of 1911, while the latter insures that all utensils used in testing milk and cream be accurate.

Legislative Plans for 1913.

At the special meeting at South Framingham, on December 3, the Board voted to present to the Legislature the following projects: —

1. A bill to provide for three years an annual appropriation of $15,000 for the encouragement of dairying by offering prizes for the best-kept stables, the lowest bacteria counts and best quality of milk; by demonstrations; by instruction by agents; by literature; or otherwise.

2. A bill providing for an open season on pheasants, and allowing farmers or other persons to destroy pheasants found injuring cultivated crops.

The Board further voted to support the bill, submitted by the Massachusetts Association of Boards of Health, providing for the protection of the public health by establishing a limit of bacteria permissible in milk intended for sale.

The first-named bill is drawn in the identical form in which both legislative committees on agriculture and ways and means reported it to the last general court as "ought to pass." It is presented in the belief that business of any kind profits, and may be boomed, by education and encouragement, and that eternal inspection and no reward would, in time, drive even the most profitable industry out of the State.

Other bills, drafted by your secretary, are called to your attention under the headings to which they relate.

Work of the Office.

The widespread awakening as to the possibilities of agriculture in Massachusetts and New England continues to be felt in the ever-increasing demand upon the office of the Board for

literature and specific information. To meet this demand it has been necessary to employ much additional office help during the year, and this we have done to the full extent which our funds would allow.

We were very unfortunate this year in the loss of our first clerk and of our assistant librarian. Mr. Howard N. Legate died very suddenly on March 28, and Miss Grace C. Hall passed away soon after that date. Mr. H. Linwood White, second clerk, was promoted to the position of first clerk shortly afterward, and Mr. Erwin H. Forbush was secured to fill the position of second clerk, being under provisional appointment by the civil service, until an eligible list should be established. A competitive examination for this position was assigned by the civil service for August 1, which Mr. Forbush passed, and his permanent appointment followed. A similar procedure was necessary in the case of the assistant librarian, and Miss May A. Connerney now fills that position. In addition to the regular office force it has been found necessary to procure additional help very frequently, and two stenographers have been regularly employed during the last three months of the fiscal year. Much work has been done upon the library, and the information which it contains has thus been made available to a much greater degree. This is a very important feature and should have the entire attention of at least one individual. A recommendation has been made for an increase in the appropriation for extra clerical assistance which I trust will be favorably considered, and I would urge that the Board instruct its committee on legislation to do everything possible to secure the favorable action of the Legislature on this increase. This will provide funds for the employment of a permanent stenographer, which, with the intermittent employment of extra assistance, will be sufficient for the present, although, if the work continues to increase at the same rate which it has done during the last few years, it will soon be necessary to have more office help. During the year a new desk has been secured and the chief deputy nursery inspector is now permanently located in the office, thus greatly facilitating the nursery inspection work, but at the same time further handicapping us for space in the office. This fact, coupled with the loss of the private office of the secretary,

and also the employment of additional office help which has been necessary, has so crowded the main office that the work is seriously handicapped. The preparation of much material which is of an original character, both by the secretary himself and by his assistants, makes it imperative that there be a room provided in connection with the office where this can be done. All committee meetings, conferences, and Board meetings must now be held in the main office, unless special requisition is made for an assignment of another room, and this is of added importance and the situation is all the more regrettable, owing to the fact that various New England organizations have looked upon the office of the Board as their logical meeting place. It can readily be seen to what an extent the work of the office is hindered by this arrangement, and with the fast-increasing volume of routine work which must be attended to, and with the additional work which is planned, the State can ill afford to cripple the efficiency of the department in any way.

As your present secretary relinquishes the activities of this office he feels that he should urge the advisability of an increase in the salary attached to this position. In accordance with the demands and the importance of the agricultural interests of Massachusetts he feels that the remuneration should be such as would attract the very best talent to the direction and development of those interests, and would urge that this matter receive your favorable consideration. This matter has previously been twice recommended by the Board.

Wild Deer.

The year of 1912 has seen no cessation in the enormous toll which deer are constantly exacting from our agriculture, — from the pockets of our farmers, who, in any case, are never overpaid for their efforts. Probably the greatest loss is experienced by the fruit growers of the State, owing to the fact that, while reparation is supposed to be made by the State upon complaint of deer damage, it is very difficult to ascertain what the damage to a young orchard really is, and the appraisers in such instances invariably set this damage at too low a figure. The promotion and proper development of our agriculture will sooner or later

demand either the extermination of these handsome but destructive animals, or else their confinement in State parks. The present law allowing the farmer to shoot them when they are caught in the act of destroying his crops is an excellent help, but he can ill afford to spend his time policing his fields and orchards. The short open season in the fall in the western counties helps out the situation, as it not only thins the ranks of the deer, but also causes them to become a trifle more wild and wary and not quite so bold in their advances. This backwardness, however, largely disappears by the following growing season, and can hardly be called a help. The following figures furnished by the Commissioners on Fisheries and Game indicate that the number of deer in the State is evidently not decreasing. Deer killed in 1911: doing damage to crops, 230; during open season, 1,269; total, 1,499. Deer killed in 1912: doing damage to crops, 313; during open season, 1,231; total, 1,544. If the welfare of agriculture in Massachusetts is to be considered, no change will be allowed in the present law which will afford any greater protection to these animals, and your secretary would urge that he be instructed to oppose any alteration in the present law, and he would even advocate fuller protection and more adequate reimbursement for the farmer rather than any change, prompted by sentiment, in favor of the deer.

Pheasants.

Investigations conducted by the Board this year, coupled with considerable disastrous personal experience of your secretary, have convinced him of the need of legislation affording the farmer protection from the pheasant. For emphasis of this matter a quotation is made from the May, 1912, issue of the Crop Report of this Board: —

> It would seem from the reports that, while these birds are not as yet plenty enough to do much damage in most sections, they will where numerous, do a good deal of damage, especially in the fall, to the ripening corn, and in the spring by digging up seed and pulling young shoots.

The result of this investigation showed plainly that, while the damage was not general, it was especially marked in all

localities where the birds were present in large numbers. Steps must be taken which will afford protection to the farmer before these birds become so numerous as to cause serious damage throughout the State. A bill to this effect, patterned somewhat after the present deer law, allowing the farmer to protect his growing crops and providing a short open season in certain counties where these birds have gained a foothold, has been favorably considered by this Board and is earnestly recommended for passage by your honorable body.

Changes in the Board.

What few changes have occurred in the personnel of the Board have resulted from the expiration of the terms of different members and the election to the Board of other representatives by several of the incorporated societies. Mr. Chas. P. Aldrich, of the Franklin County Society, retires after three years of service, and Mr. Geo. E. Taylor, Jr., has been elected from this society; Mr. Howard A. Parsons, of the Hampshire Agricultural Society, retires after three years of service, and Mr. Francis E. Farrar has been elected to the Board; Mr. Walter C. Bemis, of the Spencer Association, retires after three years of service, and Mr. Edward Warren has been elected to his seat; and Mr. Sylvester H. Peebles, of the Union Agricultural and Horticultural Society, retires after three years of service, and Mr. Henry K. Herrick will fill his place. An addition to the membership of the Board is the representative of the Quannapowitt Agricultural Society of Reading and Wakefield, which has elected Dr. Calvert H. Playdon.

Meetings of the Board.

The summer field meeting of the Board was held on the C. I. Hood farm, at Lowell, on June 21. The weather was ideal and the total attendance for the day was estimated at about 1,000. The program was an especially good one. It was opened by a demonstration talk on tools and machines used by the market-gardener, by Henry M. Howard. This was followed by a demonstration of a gasoline traction engine and gang plow by a representative of the International Harvester Company. Evan F. Richardson then gave an address on harvesting

and curing hay, and a demonstration and field trial of haying tools and machinery. In the afternoon Prof. Chas. S. Plumb gave illustrated talks on the points of the dairy cow and the hog, judging animals in each case with the use of the score card. The scene of operations was then shifted to the Geo. W. Trull farm, where an excellent demonstration of the use of dynamite in agriculture and its practical application to the various operations of the farm was given.

The public winter meeting of the Board was held at South Framingham, with the Middlesex South Agricultural Society, on December 3, 4 and 5. The program was all that could be wished for, and was more extensive than for a number of years. The lectures and discussions will appear in the annual volume. An informal reception was given to the Board by the Framingham Board of Trade. A feature of the meeting which was of much interest was an exhibit which was prepared by Dr. Chas. E. North, of the New York milk committee. This consisted of utensils and instruments necessary in the production of sanitary milk.

The annual business meeting of the Board was held at Boston on January 9 and 10, and special business meetings were held at Lowell and South Framingham.

Agricultural Societies.

The agricultural societies, as shown by the returns for the year of 1911, are generally in a prosperous condition. A comparison of the returns of the years of 1911 and 1910 shows that, disregarding the addition in 1911 of the Worcester North Agricultural and Driving Association, the aggregate market value of the property belonging to the societies increased $45,524.30, or nearly 4 per cent., and the assets increased $31,763.07, or 2½ per cent., while the liabilities increased only $8,058.31, or 1 per cent. The weather during nearly all of the fairs was propitious, and reports show that the attendance was as large, if not larger, than in former years. The societies were aided financially to a considerable extent by the increase in the bounty granted by the Legislature, and took advantage of the clause appropriating money for use in the payment of premiums to children and youths by offering such premiums at their recent

fairs. It appears, however, that the clause referred to does not do justice to the girls and boys alike, nor does it fully meet the requirements of the boys' activities alone. Your secretary recommends, therefore, that chapter 260 of the Acts of 1912 be so amended as to give proper latitude to the awarding of premiums to children and youths.

Farmers' Institutes.

The institute season of 1912 was marked more by a greater eagerness on the part of those attending the sessions for new methods in agriculture, than by mere numbers of either institute sessions or persons in attendance. One hundred and thirty-eight have been held with 154 sessions. All the societies held 3 or more meetings except the Housatonic Agricultural Society, which was excused from holding more than 1 institute, and the Nantucket Agricultural Society, which was excused from holding more than 1. These societies will be required, however, to hold enough additional institutes in 1913 to bring the total for the two years up to 6. Nine societies held 4 or more meetings, and 27 institutes were held by organizations other than agricultural societies. The aggregate attendance for the year was 18,172, or 118 per session, as against 126 last year, 110 in 1910, 137 in 1909, 111 in 1908, 118 in 1907, 127 in 1906, 125 in 1905, and figures ranging from 94 in 1899 to 109 in 1904, for previous years.

The list of speakers was thoroughly gone over and strengthened where needed. A number of new lectures are offered by speakers. On the recommendation by Mr. Henry M. Howard, of the committee on institutes and public meetings, a subject list of lectures was prepared and published in connection with the regulations of the Board and the usual list of lectures and subjects. This enables local farmers and institute managers to more readily select lectures where subject of lecture has precedence.

Your secretary attended the annual meeting of the American Association of Farmers' Institute Workers, at Atlanta, Ga., on November 10 to 15, and read a discussion of the proposition: "Would an agricultural journal giving information regularly respecting Farmers' Institutes and other forms of extension

work be desirable? If so, how could such a journal be secured and maintained?"

The increase of $1,000 requested in my estimates for the year for the "dissemination of useful information in agriculture" was granted by the Legislature. This allowed the publication of all the bulletins, circulars, nature leaflets and crop reports that time for careful editing would allow without curtailing the institute work, although more might have been done had action been taken upon the matter at an earlier date.

Apiary Inspection.

Since the establishment of the apiary inspection service on a permanent basis by the Legislature of 1911, there has been good opportunity to standardize the work and plan well into the future. This has resulted in still more efficient work during the year of 1912, and a resultant wider understanding by the horticulturists of the importance of bees to this industry and a keener appreciation on the part of beekeepers of the necessity of avoiding and combating the different bee diseases. The State has been practically covered during the past year, and conditions have proved very satisfactory. In February the convention of apiary inspectors of northeastern United States and Canada was held at Amherst. A partial report of the proceedings of this convention, containing valuable papers delivered at that time, will be printed in connection with the annual report of the State Inspector of Apiaries. The commendation of the inspection service in this State which found expression at this conference was very gratifying to this Board and to the State Inspector.

Nursery Inspection.

The work of this department has developed remarkably in the past few years. Primarily, the inspection work consisted of an examination of growing nursery stock in the field only. The recent introduction from abroad of serious insect pests and plant diseases, however, which threaten the nursery and forest interests of the State and have become a public menace, has made clear the necessity of a thorough inspection of foreign imports of nursery stock in order to prevent the further introduction of similar insect pests and plant diseases. Further-

more, the prevalence of certain insect pests in this State which as yet have not become established in other States has made necessary the inspection of all nursery stock going to points outside of the State. Otherwise, nursery interests in which several millions of dollars are invested would have to be abandoned and this important industry lost to the State. In view of the foregoing the work of the inspection service is now directed along several lines: the inspection of nursery stock in the nurseries as a protection to the nurserymen and to the public at large, the inspection of imports from abroad to prevent the introduction of new insect pests and plant diseases, the inspection of nursery stock coming from other States to determine whether it meets inspection requirements, and by a careful inspection of all stock shipped from the State an attempt is made to prevent the spread of dangerous insect pests or plant diseases into territory where these have not already become established. The inspection work at present requires the services of several men permanently, and at times as many as 35 men are required to carry out this work. The recommendation of your secretary in 1912 for an increase of the appropriation for inspection work and modifications in the nursery inspection law were favorably considered and adopted, and this important work is now upon a very satisfactory basis. The demands of the inspection service work upon the stenographic service of the office are constantly increasing, and your secretary would suggest the permanent employment by this department of a stenographer in order to relieve the present situation whereby both the inspection service work and that of the office are handicapped.

The Dairy Bureau.

The Dairy Bureau has continued its good work in the efficient and progressive manner which has, in the past, characterized all of its undertakings. The relations between the Board, as a whole, and the Bureau have also been most satisfactory, thus indicating the value of this manner of organization, which might well be applied to other activities in the agricultural work of the State. The annual report of the general agent of the Bureau will be presented at the annual meeting, and will

contain the various details of the work. The Bureau has applied for an increase of $2,000 in the appropriation for this work, which would make an annual appropriation of $10,000. The efficiency and importance of the work of this Bureau is sufficient justification for the granting of this request, and I feel that the granting of this additional amount will result in an enlargement of the work which is already being done, and this can only be a benefit to the dairy interests of Massachusetts.

The Cattle Bureau.

The above is the former title of what is now, in reality as well as in name, a separate and distinct organization from this Board, the Department of Animal Industry. While the establishment of such a department is not in accord with that highly commendable policy of consolidation and co-operation which is productive of the largest results for the agriculture of the Commonwealth, it is hoped that under the present arrangement the control of contagious animal diseases may receive the attention which is essential to the best welfare of the agricultural interests of the State.

State Forester.

The annual report of the State Forester will appear in "Agriculture of Massachusetts for 1912," and he will report in person at the annual meeting of the Board. The State Forester is very properly directing much of his attention to the development of forestry methods in Massachusetts, and so far as is possible and practicable, is endeavoring to secure the co-operation of the various cities and towns in the work of suppression of the gypsy and brown-tail moths. The original purpose of the office of the State Forester was the promotion of modern methods of forestry, which would not only conserve our forest supply, but would add to the value of this very important resource, and the State Forester is earnestly seeking to carry out this plan; the success which attends his various efforts is very gratifying.

State Ornithologist.

The different phases of the work of the State Ornithologist have progressed very favorably during the past year. The

general public sentiment toward the protection of not only our song and insectivorous birds, but also our game birds and wild fowl, has continued to increase, and Massachusetts is in the very forefront of progress in the conservation of its useful and valuable wild life. This fact is largely due to the efforts and accomplishments of the ornithologist. It is the intention of the State Ornithologist to devote his entire time to the duties of that office. This means that if the present incumbent is to be retained, and your secretary would emphasize his value to the State, the salary accompanying the office must be established in proportion to the amount and quality of the work which is demanded and which is given. The recommendation of the secretary in the last report in regard to this matter was only partially complied with, and your attention is again called to the matter. The special report which has been in process of preparation for several years was published in 1912 under the title, "A History of the Game Birds, Wild-Fowl and Shore Birds of Massachusetts and Adjacent States." This is a cloth bound volume of 630 pages, fully illustrated by the author and others, and is pronounced one of the most valuable works upon the subject which has yet been published. Free copies were provided for the Governor, Council, members of the Legislature of 1910 and various other State officials, for the high schools of the State and for the free public libraries. The balance of the edition is now on sale through this office at $1 per copy, the same price at which "Useful Birds and their Protection" is sold.

Massachusetts Agricultural College.

The hearty co-operation in all progressive undertakings which has been a feature of the relations between this Board and the agricultural college in the past has characterized all the various efforts during the year of 1912. The experts of the college and experiment station have readily responded to the various calls made upon their time and energy for lectures before the Board, for institute service and for essays which have been incorporated in bulletins and other publications of the Board. On the other hand, copies of the different publications have been supplied for the circulating library of the extension service, and, to a limited extent, for the regular

college courses. At the present time the buildings and equipment of the college itself are hardly adequate to the demands made upon them. It is to be hoped that the incoming Legislature may see fit to grant such requests for additional buildings and equipment as, in the opinion of those in charge, are needed. To this end, then, it would seem to your secretary that the energy of those who are directing the development and growth of the college should be applied, first of all, to the development of the college as an institution to which every son of Massachusetts who has the desire may turn, with the assurance that nowhere can be obtained a more adequate training in the principles and practice of agriculture. Centralization of effort is productive of the largest results, and surely such results are what we most desire and what the people of the State most deserve from this one of the educational institutions of the State which is peculiarly their own.

Massachusetts Fruit Show.

Believing that the interests of the fruit-growing industry in Massachusetts could best be served by the holding of an exhibition in the State every year, instead of every other year, as is the case with the New England Fruit Show, the Board of Agriculture was instrumental in the planning of the first Massachusetts Fruit Show, and was greatly assisted in the carrying out of the undertaking by the Massachusetts Fruit Growers' Association. The appropriation of $2,000 for special exhibitions was this year partially devoted to this purpose, and the show was held in Horticultural Hall November 7–10, in connection with the annual chrysanthemum exhibition of the Massachusetts Horticultural Society. At this show was again presented to the great consuming public of the city of Boston, and all others who chose to attend, some of the choicest fruit obtainable, all grown right here in Massachusetts. This method of advertising the products and the possibilities of our Massachusetts soil cannot be too highly commended. The attention which the various exhibits of fruit attracted was very gratifying and was also indicative of the ever-increasing interest on the part of the consumer in native-grown products. As a sort of supplement to the fruit show an exhibition of some

of the prize apples was arranged in one of the show windows of Wm. Filene's Sons department store, which attracted unlimited attention. An effort was even made to have it removed, as it was the cause of blockading traffic at that point. This only shows what an interest there is in our native products.

New England Corn Exposition.

This organization, in accordance with their plans, held the second biennial corn exposition in Horticultural Hall, Boston, Nov. 20 to 24, 1912. This exposition was an excellent one. The exhibits showed that the interest in corn growing in New England is on the increase, and that the farmer is learning and adopting better methods in the growing of this crop, which tend to produce not only more and larger kernels on every ear, but also more bushels to every acre. The attendance at the show indicated that the general public in and around Boston failed to appreciate the significance of the show itself, and of the great industry which it represents. These expositions should have the widest publicity on the part of the press, in order that their full value may be realized. This Board, out of its appropriation for the holding of special exhibitions, furnished financial aid in prizes to the amount of $567, and your secretary feels that this aid was heartily deserved and that the money was expended to very good advantage.

American Land and Irrigation Exposition.

The Board of Agriculture last year requested from the Legislature a special appropriation of $3,000 for the purpose of making an exhibit of agricultural products at the American Land and Irrigation Exposition, which was to be held in New York Nov. 15 to Dec. 1, 1912. This exposition in 1911 was an exceedingly creditable showing of the products and opportunities of the various States. Massachusetts, in conjunction with other New England States, prepared and exhibited a most excellent collection of the products of this section. There is little doubt that the resultant effects of this exhibit have been very beneficial to New England, calling the attention, as it did, of the residents of the great metropolis to the opportunities which lie so close at hand in the hills and valleys of Massa-

chusetts and other New England States. This exhibit was made at a great sacrifice to all concerned, as the money available for the purpose was by no means sufficient, even though the New England railroad lines secured and paid for the necessary space in the hall. Realizing that they would probably not be willing to do this in 1912, an appropriation of $3,000 was asked for, which, with the amounts which might be raised by the other States, was deemed sufficient for the purpose of making an adequate show. This amount was curtailed in the progress of the bill through the last Legislature and $2,000 was finally appropriated for the purpose.

The management of the exposition raised their rates for the 1912 exposition, so that the necessary space would have cost nearly the total sum appropriated. A strong effort was made to induce the New England lines to again assist in this exhibition to the extent of furnishing the space. This, however, was unsuccessful. The matter was taken up with the management of the show, who put forward a proposition whereby space could be secured. A conference of the secretaries and commissioners of agriculture in New England was called, at which a representative of the show was present and put forward a plan whereby your secretary was to authorize him to solicit funds among the business houses of Boston and vicinity, with which to supplement the appropriation granted by the Legislature, in order that sufficient space might be purchased. In view of the fact that the Legislature had granted an appropriation, it was deemed hardly expedient to allow such solicitation. The result of the matter was that no exhibition was made at this exposition, as it was deemed unwise to make an exhibit which would be in any way inferior to the showing which was made the previous year, and the money appropriated for the purpose has reverted to the treasury.

Exhibit of the Work of the Board.

Although other requests for an exhibit of the work of the Board were made, the only one which could be arranged was that in connection with the annual fair and show of the Mansfield Poultry, Pigeon and Pet Stock Association, held at Mansfield on December 11 to 14. The exhibit consisted of sample

copies of all the publications of the Board displayed so as to be easy of access to the public, and production charts showing the localization of the various farm industries of the State. This exhibit was shown in conjunction with that demonstrating the commercial packing of apples in boxes, mentioned elsewhere.

The Farm Catalogue.

The fact that the Legislature of 1912 failed to grant an appropriation for a new edition of the farm catalogue, published by this Board the previous year, has been a source of very keen regret to your secretary. This regret has been increased rather than diminished during the year by the numerous and urgent calls for information in regard to available farm lands in the State. Not only has the demand from this State been incessant, but the calls from other States in the east, in the middle west, and from the Pacific coast States have been amazingly large. It is quite evident from these calls that the relative status of agriculture in the west, in comparison with the opportunities here in Massachusetts and New England, is far below what it was some years ago. The fact that practically all of the free land of the west had been taken up several years ago, and the further fact that land values are very excessive and irrigation must be practiced if satisfactory crops are to be raised on some lands in the west, have caused the people in those sections, and especially those who know the conditions here in New England, to turn their attention back to the east. Massachusetts is very shortsighted, indeed, if she does not make an effort to meet this call for her agricultural lands, as well as to supply the call for information for available farms from within her own borders and from other States close at hand. There are but few copies of the edition of 10,000 copies printed in 1911 left for distribution, and indeed it is hardly fitting that this information should be distributed as authoritative or up-to-date, as many of the farms have since been sold, while the owners of others, upon ascertaining the demand for such land, have decided not to dispose of their farms. A new list of available farms should be compiled, and the information in regard to the status of agriculture in the Commonwealth, which former editions of this publication have

contained, should be revised and brought up-to-date, in order that the bulletin may continue to be as interesting and valuable as possible. The demand for this bulletin has far exceeded that for any other publication of this Board. This demand has also been more universal than for any other publication, and not a day goes by which does not bring a number of calls for this bulletin. As the people of the State indirectly pay for the various publications of this Board, as well as those of other departments, it would seem fitting that we should print what is most in demand by them, and if we are to do this your honorable body must most assuredly grant an appropriation for this purpose. One of the recommendations of the Board is for an appropriation of $3,000 to be devoted to gathering, preparing, publishing and distributing this material.

The Encouragement of Orcharding.

The committee on orcharding and fruit growing, in considering plans for the expenditure of the annual appropriation of $500 for this purpose, finally decided that the packing and marketing of apples was the one feature which needed attention more than any other. It was, therefore, decided to prepare an exhibit, showing the various methods of packing fancy fruit in boxes, and present this exhibit at a series of the fairs of several of the agricultural societies. A schedule was prepared and the exhibit was shown at fairs on the following dates and at the places named: —

Hoosac Valley Agricultural Society, at North Adams, August 30, 31 and September 2.

Highland Agricultural Society, at Middlefield, September 4 and 5.

Deerfield Valley Agricultural Society, at Charlemont, September 12 and 13.

Franklin County Agricultural Society, at Greenfield, September 18 and 19.

Spencer Agricultural Society, at Spencer, September 20 and 21.

Hillside Agricultural Society, at Cummington, September 24 and 25.

Worcester West Agricultural Society, at Barre, September 26 and 27.

Eastern Hampden Agricultural Society, at Palmer, October 4 and 5.

At the present time the market package for apples in the western part of the State is the barrel, almost universally, and the object of this exhibit was to attract attention to the superiority of the apple box in the marketing of choice varieties of apples. It was felt that this undertaking was very successful in that the interest manifested in the exhibit was very great, and the public in general seemed very anxious to discuss the matter with the one in charge of the exhibit, and to learn everything possible in regard to this method of marketing fruit. It was also felt that this exhibit was of further benefit to the several societies in the shape of an added educational feature at the various fairs, and as such was fully appreciated.

Poultry Premium Bounty.

This bounty was disbursed to the incorporated poultry associations, in accordance with the regulations governing this fund. The full amount was awarded, and each society received its proportionate share, based upon the amount paid out by that society for the specified purposes. The following list shows what societies received bounty and the amount to each: —

Dalton Poultry, Pigeon and Pet Stock Association,	$56 11
Eastern Massachusetts Poultry and Pigeon Association,	55 05
Holyoke Poultry and Pet Stock Association,	215 55
Milford Poultry Association,	121 64
New England Poultry Association,	72 62
Northern Berkshire Poultry Association,	142 16
Springfield Poultry Club,	208 98
Worcester Poultry Association,	127 89
Total,	$1,000 00

In connection with this subject, it occurs to your secretary that it would be advisable to establish a system of inspection of these poultry exhibitions somewhat resembling the system which is employed in the inspection of the annual fairs of the various agricultural societies. I would call this to your attention, believing that it is a matter which could very practicably and profitably be put into operation, thus not only bringing

the associations and the Board into a closer relationship, but also serving as a source of encouragement and profit to the different societies to feel that there was an active interest on the part of the Board in their welfare and progress

Bulletins of Massachusetts Agriculture.

The demand for these bulletins, which probably form the most important series of publications of the Board, has again shown a rapid growth, and it has been necessary to issue new editions of three of the five bulletins. At the time of the last annual report the supply of the second edition of Bulletin No. 2, entitled "Orcharding," was exhausted, and plans were under way for the third edition. This was issued in May, 1912, under the title, "Apple Growing," as it was thought that this subject more accurately described the contents of the bulletin. An index was also compiled and added to this bulletin, it being felt that this would add to the availability of the knowledge contained in the various articles. This feature will be incorporated with all future editions of these bulletins. Several articles contained in the second edition were dropped from this issue and new material added to take their places and to further strengthen the bulletin. This process will be continued with each edition, thus keeping the bulletins strictly up to date. Bulletin No. 1, entitled "Poultry Culture," was also reprinted this year, making the third edition of this popular publication. The census figures contained in this bulletin were revised by adding an appendix to the volume, giving the recent figures of the 1910 federal census in regard to the industry. An index was also added to this bulletin. Another feature was incorporated with this edition of Bulletin No. 1, which is an extremely valuable one and which will form a part of other bulletins in the future. This is a bibliography of other available literature on the subjects treated in the bulletin, including bulletins published by the different experiment stations and by the government, and also a list of books upon the subjects which are available and the prices of them. In December the second edition, revised, of Bulletin No. 4, entitled "Small Fruits and Berries," was received from the printer. This also contains an index and bibliography. All three of these bulletins are now

experiencing an ever-increasing demand, indicating not only the increased interest in agricultural topics, but also attesting to the fact that the public is becoming more universally aware of the fact that such literature is available. The unsolicited expressions of commendation of these different publications are very gratifying, and are increasing in proportion to the greater demand. The supply of Bulletin No. 3, on "Grasses and Forage Crops," is now running low, and a new edition of this bulletin will soon be necessary. This will be published, revising the material already in the publication and adding any new material that is deemed timely and of value. It is proposed to issue a bulletin on dairying during the present winter or spring, or as soon as sufficient material can be gathered together for the purpose. Several other bulletins on different subjects are badly needed and will be issued as fast as funds and opportunity will permit.

Crop Reports.

The monthly crop reports were issued during the past year from May to October, as usual. Several issues contained articles and information of special and timely interest in addition to the regular information. The special bulletins contained in the different issues for the year were, in order, as follows: "Pork making for Massachusetts farmers," by Dr. Geo. M. Twitchell; "Irrigation in Massachusetts," by Henry M. Howard; "Silos and silage," by H. O. Daniels; "Ducks and geese," by John H. Robinson; "Pruning the apple tree," by Dr. C. D. Jarvis; and "Some suggestions on barn building," by Prof. J. A. Foord. The editions for the different months consisted of the following numbers: May, 7,900; June, 7,900; July, 7,900; August, 7,900; September, 8,000; October, 8,200. The largest previous edition was that for October, 1910, which consisted of 7,300 copies. Considering the fact that the mailing list for the Crop Report had not been revised for some years, and also taking into consideration the fast increasing size of the list, it was decided to revise it, and a plan for this purpose was formulated in this office, the result of the execution of which will be that the size of the list for 1913 will be considerably smaller. This plan was carried into effect with the October

edition, and was such that every one who was really interested in the report could have it continued by simply filling out a form and returning it to this office. The return of these notices has been surprisingly large, considering the fact that the list had not been revised for such a length of time, and some of the voluntary remarks of commendation which accompanied the returns were very complimentary to the report and very gratifying to the secretary. By this revision a considerable sum will be saved to the Board in both the printing and in the distribution of the crop reports, but this will not be for long, as the increased interest in things agricultural is especially manifest in the larger number of calls for our various publications, and especially for the Crop Report, as this is the only regular mailing list which we maintain.

Publications.

The following publications were issued by this Board during 1912, and may be secured upon application to the office: —

	Pages.	Number.
Agriculture of Massachusetts, 1911,	715[1]	15,000
Crop Report No. 1,	48	7,900
Crop Report No. 2,	44	7,900
Crop Report No. 3,	44	7,900
Crop Report No. 4,	40	7,900
Crop Report No. 5,	48	8,000
Crop Report No. 6,	60	8,200
Massachusetts Agriculture, Bulletin No. 1,	172	3,000
Massachusetts Agriculture, Bulletin No. 2,	180	3,500
Massachusetts Agriculture, Bulletin No. 4,	157	3,000
Circular No. 1,	8	25,000
Nature Leaflet No. 8 (reprint),	4	1,500
Nature Leaflet No. 15 (reprint),	8	1,500
Nature Leaflet No. 22 (reprint),	8	2,500
Nature Leaflet No. 23 (reprint),	8	2,500
Nature Leaflet No. 24 (reprint),	8	2,500
Nature Leaflet No. 25 (reprint),	8	2,500
Beekeeping, Some Essentials of (Apiary Inspection Bulletin No. 5).	20	1,500

[1] Including twenty-fourth annual report of the Massachusetts Agricultural Experiment Station, 237 pages.

	Pages.	Number.
Home Garden, The,	12	3,000
Production of Sanitary Milk,	14	5,000
Soiling and Summer Silage,	16	500
Annual Report of State Inspector of Apiaries (Apiary Inspection Bulletin No. 4).	8	1,500
Annual Report of State Nursery Inspector,	14	1,000
Annual Report of State Ornithologist,	32	3,000
Annual Report of Chief of Cattle Bureau,	28	500
Directory of Agricultural Organizations,	28	100
Farmers' Institute Pamphlet,	32	500
Special Report by State Ornithologist on Game Birds, Wild Fowl and Shore Birds.	638	5,000

Legislative Appropriations.

Objects for which appropriated.	1912.	
	Appropriation.	Used.
Traveling and necessary expenses of the Board,	$1,300 00	$1,304 01
Salaries of secretary and clerks,	6,200 00	5,990 00
Traveling and necessary expenses of the secretary,	500 00	456 75
Lectures before the Board and extra clerical assistance,	1,600 00	1,599 04
Incidental and contingent expenses, including printing extracts from the trespass laws.	1,500 00	1,537 37
Dissemination of useful information in agriculture,	6,000 00	5,163 99
Printing 15,000 copies "Agriculture of Massachusetts,"	6,000 00	5,595 79
Bounties to agricultural societies,	31,000 00	22,807 56
Poultry premium bounties,	1,000 00	1,000 00
Encouragement of orcharding,	500 00	498 60
Exhibit at American Land and Irrigation Exposition,	2,000 00	-
State apiary inspection,	2,000 00	1,997 98
State nursery inspection,	12,000 00	11,171 61
State Ornithologist, salary and expenses,	2,000 00	2,015 36
Special exhibitions,	2,000 00	1,998 34
Work of the Dairy Bureau, including salaries,	9,800 00	9,675 00
Totals,	$85,635 00	$72,817 30

Extracts from the Trespass Laws.

As each year goes by and the public becomes more extensively aware of the fact that this Board has the cloth posters containing extracts from the trespass laws for free distribution,

the demand for these posters gradually increases, thus entailing not only a greater expense, but also demanding more and more time on the part of the members of the office force. Each post office in the State was again furnished a copy printed on cardboard for posting in the office.

Conclusion.

With this, the sixtieth annual report of the State Board of Agriculture, the present secretary brings to a close a decade's service in this capacity. The improvement of agriculture as a whole, of social life in the country, of life in the farm home, of farm methods and farm practice, during this period, has been very marked, and, indeed, very gratifying, in view of the efforts of this Board and other organizations toward this end. I feel that the members of the Board are to be congratulated in the amount of work which has been undertaken, and in the results that have been attained. During the past ten years the Board has led in numerous progressive movements. In addition to the fact that the Board has for years had charge of the regulation and promotion of the farmers' institute work in the State, which is, perhaps, the principal means of bringing to the farmer the agricultural knowledge which is constantly being made available, the Board was the leader in the introduction of field meetings for the demonstration of modern methods in the various farm operations, it was the first organization to undertake orchard demonstration work, and it was foremost in promoting the adoption of modern methods of grading and packing choice apples for market. The organization of the New England Fruit Show, which has been productive of such wonderful results, was planned in the office of the Board, and a large share of credit should be given for its successful realization. The New England Corn Show was also fathered by this Board. The co-operation of the Board in the conducting of the better farming trains was of assistance in making this enterprise the success it proved to be. Other movements are now under way, which upon their successful completion will doubtless result in like beneficial results to other phases of our agriculture. The Board does not wish to unjustly claim credit for the great progress in agriculture

and in country life that has been made, yet I believe that the Board is fairly entitled to a liberal share of credit for this progress, in view of its unstinted labor and constant activity toward this end.

It is of interest at this time to take a retrospective view of the accomplishments of the Board since its inception and organization, more than half a century ago. Through all these sixty years the Board has continued its work along advanced lines, but under the same laws which established it in 1852. As we look back down the years, those who are familiar with agricultural thought and activity will readily see that the wisdom and foresight of those who were instrumental in framing the laws for the establishment of the Board have been fully vindicated in its achievements and in the energy and enterprise which has been shown by the Board in the advancement of every forward movement. During my own tenure of office, I feel that substantial progress has been made in the agriculture of Massachusetts, much of which can justly be attributed to the efforts of this Board. As I relinquish the active duties of the secretaryship I desire here to express the satisfaction and pleasure which I have taken in the work and to call attention to the fact that, in my opinion, this Board, as it is now organized, and as it is now conducted, is and must continue to be the State Department of Agriculture. The closer a department can be brought into touch with those whose interest it is designed to serve, the more efficient will be the service. No organization could be devised whereby this Board could be brought into closer contact with the farmers of the State than the present arrangement, as the Board membership is composed of delegates from the various incorporated agricultural societies. These members, leaders in thought and progress in their respective societies and in their communities, and distinctively representative of our farming population, bring to the Board, and thus to the agriculture of the Commonwealth, the greatest enterprise, the fullest knowledge, the largest wisdom and the sanest counsel that can be secured for the advancement of agriculture, — the basic industry of the nation. In conclusion, and in confirmation of my own expressed views in regard to the efficiency of the present arrangement,

I beg leave to quote from the inaugural address of the late Governor William E. Russell, as follows: —

The State Board of Agriculture is one of the oldest of our boards, and represents an industry most important to our people and to our Commonwealth. Its membership consists almost wholly of practical men, thoroughly conversant and in touch with that great industry. With their knowledge, experience and personal interest in agriculture, they are especially well fitted to deal with all matters and laws relating to it, and to act for the Commonwealth where she touches agricultural interests.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

Summary of Crop Conditions, 1912.

The month of May opened with several days of seasonable temperature which was followed by a short cool spell, and the rest of the month was about the average, the mean temperature being slightly higher than the average for the month. The rainfall was fairly well distributed through the month with amounts ranging from average up to two inches above. Generally speaking, the weather was not very favorable for planting operations, and at the close of the month the season was from ten days to two weeks late. The excess of rain filled the ground with water to such an extent that it was impossible to plow much of the land. This rain, on the other hand, was exceedingly beneficial to mowings and pastures, and following the severe drought of the two preceding seasons greatly benefited the dried-up sward. Fall seeding wintered fairly well, although the winter was a very severe one. The fruit bloom was reported, generally, about normal, although somewhat late, with the exception of peaches, which were badly winter-killed. There was very little frost injury. The cold wet weather was an excellent check to the activity of insect pests, and very little damage was reported for the month of May, most of this being done by the tent caterpillar. Planting was very much behind, owing to the backward season and scarcity of help, and great fear was felt that if seed was put in the ground it would rot before germinating. On high ordinarily dry land germination was excellent. Farm help appeared to be very scarce, and the percentage of good help small; the average pay with board was estimated to be from $25 to $30 per month. Replies to the query as to pheasant damage gave striking evidence of the danger of allowing this bird to become too plentiful, as in sections where this has happened great damage to crops has resulted.

During the month of June no rain, except scattered showers, fell throughout the State, and conditions at the close were just the reverse of the previous month. The conditions were exceedingly favorable for the growth of the hay crop and were conducive to a good growth of vegetation in general. With the advent of the warm weather insects became active and did considerable damage during this month, potato beetles being reported as most destructive in the greatest number of instances, although cutworms, tent caterpillars, gypsy and brown-tail moths, and the elm-leaf beetle, were quite generally reported. Corn was very late at this time, much seed having rotted in the ground so that many fields had to be replanted in whole or in part. The rains of early spring were not sufficient to offset the damage done by the droughts of the previous years, and the hay crop was not quite up to normal. Acreage of early potatoes was less than usual, and in places only late varieties were planted, owing to the excessive wet weather of May. All market-garden crops were backward but looked fairly well at this time. The supply of dairy products was somewhat smaller, and prices were a little higher than last year. Dairy cows were reported scarce in number and high in price. Although the early rains probably helped out pastures, they were at this time beginning to show the effects of the dry weather. The prospect for apples was fair to good; peaches and pears a light crop; plums were about as usual; cherries were a normal crop; strawberries yielded well in most sections, the earlier varieties showing up better than the later. Other berries offered bright prospects provided sufficient rain was forthcoming. Local frosts from the 6th to the 10th and from the 13th to the 15th did some damage in various parts of the State. The special question in regard to irrigation showed that this method of supplementing scanty rainfall is practiced only in the market-garden sections in the vicinity of the larger cities.

The drought continued during the month of July with disastrous effects in some cases. The reports on insect damage showed that the potato beetle was doing the greatest amount of damage, and the elm-leaf beetle and plant lice were quite generally reported. Indian corn at this time was about two

weeks, or possibly more, behind the average, and fear was felt that it would be necessary to put all in the silo or feed it green. The drought was disastrous to the hay crop, and although the quality was excellent, the quantity of the crop was much below normal. Forage crops felt the effects of the drought quite severely, but the rains about this time were of much benefit to these crops. Market-garden crops proved rather unsatisfactory, and early potatoes were very nearly a failure. The drought caused disastrous dropping of fruits; apples promised somewhat more than a half crop; pears a rather light crop; peaches, in general, a failure; plums a fairly good crop; quinces poor; grapes a very good crop, and cranberries about 50 per cent. Pastures at this time were very badly dried up, and farmers found it necessary to feed hay and grain. Small grains were seriously affected by the drought, and where not a total failure, yielded poorly. Some new apple orchards were set out, but the acreage was not especially large. The returns from the questions as to silos and silage indicated that less than one-half of the dairy farms of the State made use of the silo, and attention was called to the fact that in some localities the farmers were going out of the dairy business, owing to the high prices of grain and hay and feeds, and to the further fact that a living price could not be secured for dairy products.

The month of August was somewhat more favorable to vegetation. Corn, although uneven, and from ten days to two weeks late, promised fairly well at this time. The rowen crop did not promise well, and only early cut low lands promised a full crop. Late potatoes, while checked by the drought so that they were somewhat late, showed a good growth of vine at this time and promised a fair to medium crop, with very little rot, although the blight was in evidence. The tobacco crop was reported fully up to the average in quantity and quality. The prospect for apples was about a 60 to 70 per cent crop; pears, rather a light crop; peaches, a failure; grapes, a good crop; quinces, fair; cranberries, rather small. Although pastures were badly affected by the drought they recovered during the rains of August so that they were in better condition than for some years past at that time. Although feed

was still quite short, late market-garden crops at this time promised very good results.

The month of September was very favorable to agriculture, the absence of frosts allowing the crops, which were late, owing to the drought early in the season, to mature in fairly good shape. The rainfall, however, was slightly below the average for the month. The corn crop proved to be a very satisfactory one, probably about 88 per cent of normal for the State. Rowen came along in good shape, and a better crop was harvested than was indicated earlier in the season, although in some sections the crop was very light. Fall feed was reported in better condition, even, than rowen. But for the generous rains and warm weather during this month, grasslands would have been in a sad condition. Very little fall seeding had been done at the time of report, but this little was in good condition. The onion crop was about an average one, or slightly above, while prices ranged rather low. The potato crop turned out fairly well and was nearly up to normal and of very good quality, unusually free from scab. Late market-garden crops and root crops were very good, conditions during the month of September having been ideal for these crops. The apple crop was estimated at this time at about 68 to 70 per cent of an average crop, of excellent quality; pears were about a 55 per cent crop, of good quality. The southeastern counties of the State reported about a one-half crop of peaches; the rest of the State reported practically none; grapes proved to be a very good crop; cranberries were from 65 to 70 per cent of average, with more or less damage from insects. Only slight damage was done by frosts during the month of September, and this was only local. While neither early nor late frosts have done serious damage, it is a noteworthy fact that not a month passed during 1912 which was not accompanied by more or less general frosts in different parts of the State. The replies to the question upon "Apple growing" were of great interest, in that they plainly indicated the increased amount of interest and activity which have resulted in larger yields of better fruit.

The absence of killing frosts through September and early October, proved to be the salvation of the corn crop, the returns in the October Crop Report showing a decided im-

provement over the general conditions of early fall. Not only was there an absence of killing frosts, but the weather was dry and warm until the majority of the crop ripened off. In general, the quantity and quality of the crop seemed to be somewhat better in the eastern half of the State. For the State, as a whole, the crop was 90.6 per cent of normal in quantity and 92.8 per cent in quality, divided up by counties as follows (100 represents normal, and for each county the quantity is given first): Berkshire, 82, 74; Franklin, 84, 80; Hampshire, 87, 87; Hampden, 90, 94; Worcester, 87, 89; Middlesex, 91, 92; Essex, 93, 92; Norfolk, 96, 94; Bristol, 81, 94; Plymouth, 95, 100; Barnstable, 102, 97; Dukes, 100, 100. Taken as a whole, the season was not especially good for root crops. In general the crop was about up to the average or slightly below. The excessive wet weather and the drought which followed both did their share in preventing a full germination. Onions were an especially good crop, but prices have been very unsatisfactory. The dry weather of late fall was not conducive to the fullest development of turnips and other roots.

Pastures started in good shape with the abundant rains of the spring. In June the drought began to make itself felt, and in July pastures were generally reported as badly dried up and burned. The rains of late July, however, came to their relief, and after that time feed greatly improved, continuing excellent well into the fall. The condition of farm stock is dependent upon feed and care. Care being practically uniform each year the question resolves itself into one of feed alone. This year was no exception, and stock is generally reported as from fair to good, although considered a trifle thin, in some cases, owing to the drought, during which time it was necessary to feed hay and grain.

The dry weather during the fall was detrimental to fall seeding. The rains later in October, however, have helped out greatly. Early seeding was reported in better condition than the later sown fields. Reports seem to show that a somewhat smaller amount of seeding than usual was done during the fall, owing to unsuitable weather conditions.

In general, prices have ranged about the same as in former

years, although there has been a slight tendency toward higher prices, with several exceptions in the case of individual crops. Seventy-seven correspondents report prices in general as normal, 25 report them above, and 17 as ranging below. Prices of potatoes, apples and onions are reported low in a large number of instances. Tomatoes and cauliflower are spoken of in some instances as below the normal in price. The tendency of market prices has been somewhat irregular throughout the season.

It is unavoidable that there be a wide difference of opinion as to the most profitable crops of the year, this difference conforming to the specialties of the different sections, to the activity of the farmers in each section, and to the varied conditions obtaining in different localities. A compilation of the returns, however, reveals the following facts: the five most profitable crops, together with the number of times each was included in the selected list, were as follows: corn, 92; hay, 90; potatoes, 67; apples, 55; and tomatoes, 14. As to the five most profitable, *taken in order*, the largest number unite upon the following list: first, hay, 53; second, corn, 37; third, potatoes, 28; fourth, apples, 16; and fifth, tomatoes, 5. Figures as to the least profitable crops were compiled in the same manner as above. That corn, potatoes and hay appear in both lists is due to the fact that they were universally reported upon, and they must be balanced against each other in order to get a correct idea of their status. The least profitable crops, according to the returns, together with the total number of times each was included in the selected list, were as follows: potatoes, 27; cabbages, 19; pears, 18; peaches, 15; root crops, 15; and vine crops, 15; the last three were tied for fourth place. As to the least profitable, *taken in order*, the largest number unite upon the following list: potatoes, 14; peas, 8; cabbages, 7; vine crops, 5; hay, 2; corn, 2.

Crops, in general, were very good, but so many other problems enter into the problem of a "profitable season," that many report unfavorably. The scarcity and high price of help, low prices for certain products which were abundant, excessive cost of repairs to tools and buildings, high prices of grain and feeds, the high cost of living, — all these were cited as militating against a profitable season for the farmer.

Vegetation during the latter part of the summer had an opportunity to recover from the drought, but the dry weather of the late autumn had begun to show its effect at the time the last report was made. Streams, springs and wells were very low, not having recovered. Consternation was felt for the winter water supply at that time, but the rains the latter part of the month helped out the situation very much.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE

AT

SOUTH FRAMINGHAM.

DECEMBER 3, 4 AND 5, 1912.

PUBLIC WINTER MEETING OF THE BOARD,

AT SOUTH FRAMINGHAM.

The annual public winter meeting of the Board, for lectures and discussions, was held in Union Hall, South Framingham, on Tuesday, Wednesday and Thursday, December 3, 4 and 5. The lectures were especially good, each speaker taking great pains to deal with his subject in a complete and lucid manner. This resulted in discussions of the various topics, which were of unusual interest and value and were participated in by a large proportion of those present.

The meeting was called to order at 10.30 A.M., on Tuesday, by Secretary Ellsworth, who then introduced Mr. John P. Bowditch of Framingham, chairman of the board of selectmen and president of the Middlesex South Agricultural Society, who delivered the address of welcome.

ADDRESS OF WELCOME, BY JOHN P. BOWDITCH.

I consider the town of Framingham very fortunate, indeed, in having the State Board of Agriculture hold its meeting here this week. I also think that the State Board is fortunate in having its meeting in a town where the latch-string of welcome is always hanging outside, and where every hand is ready to shake the hand of the stranger in welcome and take him to the fire and the board. I also think you are fortunate in coming to such a center of agriculture, for Middlesex County ranks second of all the counties in the State in the value of its agricultural products, and the town of Framingham holds fortieth place of 350 towns in the State in the value of its agricultural products.

The importance of agriculture, I think, no one can deny. It is the basis of everything, the backbone of every country; and if any one doubts this assertion at any time I think he would be very quickly reminded by the inner man if there

should be a cessation in agricultural activity. Forty years ago New England agriculture received a severe blow, at the time of the opening up of the cheap land in the west, when a man could go out there, and take up 100 or more acres of very fertile land at a few cents or a few dollars per acre and raise crops and ship them east and underbid the men here. Then began the desertion of New England farms and the decline of our agriculture. Since that time there has been a great change; the population of the west has increased, the land that used to be open for grazing is now under fence, and the prices there are as high, if not higher, than they are here. I think there is no section of the country to-day that offers a greater opportunity in agriculture than New England and Massachusetts.

In 1885 the value of the agricultural products of Massachusetts was $42,000,000; in 1895, ten years later, this had increased to $57,000,000; in 1905 it had again increased to $72,000.000; and since 1905 our agricultural products and our agriculture generally have been increasing in even larger ratio. I think there is very little doubt that by 1915 we will have reached the $100,000,000 mark.

During the last ten years the interest in agriculture shown by the people in general and by the farmers in particular, and the interest in cooperating with the agricultural college, have increased enormously. Ten years ago there was very little doing in the office of the State Board of Agriculture at the State House, and to-day there is a large force of clerks working from morning until night on the inquiries that come in, which are enormous in quantity, and the work they do is tremendous and "all to the good." During this period of growth in the last ten years the name of one man will go down in history as intimately connected with every movement for the growth and the welfare of Massachusetts agriculture. I refer to the Hon. J. Lewis Ellsworth. It is with sincere regret that we have recently learned of Mr. Ellsworth's intention of retiring from office. He will leave a vacancy which it will indeed be difficult to fill, and we shall all miss him in that office.

I think it will be well for a moment to consider the methods of the State Board of Agriculture. The State is divided up into 32 districts, and each one of the districts has an agricultural society holding a charter from the State. These societies hold annual fairs where the farmers compete with their produce and with their stock, and where the farmers' wives compete in the household arts. Each one of these societies elects a delegate to the State Board of Agriculture, and the man is invariably chosen who is best fitted, from his experience and interest in agriculture, to represent his district. In addition to these men are three men appointed by the Governor and Council, and this makes up the State Board of Agriculture. In other words we see in the State Board the very essence of the agricultural exertion and advancement of the State, and all that is good for the welfare and advancement of this important industry.

A farmer, I think, has to be a little of everything; he has to be a business man, a laborer, a mechanic, a carpenter; he has to know about gasoline engines; he has to know electricity; and there are times when he has to show the elements of being a saint, and I think that is when he has trouble with his help. A few months ago I had an awful time with labor, and I remember one week in particular when I spent all my time in various employment offices being told I was an undesirable man to work for, and I had nothing to say in return.

Now, I think the State Board is to be congratulated upon the excellent program which they have arranged for this meeting, for we have eminent lecturers from all over the country who will cover the many different phases of agriculture.

As a member of the board of selectmen of the town of Framingham, as an officer in the agricultural society, and as a farmer I wish to welcome the State Board of Agriculture to Framingham with all my heart, and I hope that you will have an unusually successful meeting.

Secretary Ellsworth then introduced Mr. John Bursley of West Barnstable, the first vice-president of the State Board of Agriculture, who delivered the response for the State Board and presided during the remainder of the morning.

RESPONSE FOR THE BOARD, BY JOHN BURSLEY.

I think that that illustration of a farmer being a little of everything pretty nearly fits my case, for to take a farmer who has this morning milked his cows and come more than 100 miles, and expect him to respond to this welcome that we have heard, is a feat which takes a little of everything in a farmer. Now, I say to you, Mr. Chairman, that I know our Board appreciates your invitation. Those of us who are the older men in connection with the Board remember the very pleasant meetings and pleasant receptions held here somewhere along in 1904 or 1905, and a few of us, possibly, like myself, remember the meeting here in 1884 or 1885, and we also remember the cordial welcome that we received at both of those meetings and all the information that we gained from the speakers there present, and I know that this meeting will not be different from those. It will be fully the equal of them, I am sure, after scanning the program that the secretary and his advisers have prepared, and knowing as I do what the good people of South Framingham and the adjacent country will do in the line of attendance and interest.

I think I may be pardoned, Mr. Chairman, if at this time I go a little bit into raking up some of the old thoughts that come into my mind, and possibly, as I have been connected with this Board for nearly two decades, I may be allowed to tell you a little something of what our work is. What our work was and what it is now are two very different propositions. During the last decade, even, the work that the Board is called upon to do through its executive officers has more than quadrupled. You yourself, sir, alluded to the fact that the business had constantly increased, and I think you put it small; I think it has increased much more than even you are aware of. The countless inquiries that the office is receiving through the mail and through personal applications on matters connected with our agricultural interests is hard to imagine unless one is in daily touch with the office and the demands there are upon it; and it is

because there is that large increase in all agricultural work here in the State to which you have alluded that these calls are so necessary, and I believe that with the filling up of our country there are going to be more and more calls. People are finding that if they are to live, that living must be brought from the soil, and all of us, as you, sir, said, depend upon our rations about three times each day.

Ladies and gentlemen, I want to close by saying that this Board of Agriculture, is, through its secretary and officers, increasing all the time its knowledge and usefulness. A few years ago prominent speakers before us argued that we carry out certain methods which, if our secretary to-day does not condemn them as heresy, I know that the State Board of Health will; so we have got to learn and study better methods if we are going to achieve that success which we all, as New England farmers, desire.

Mr. Chairman, I thank you in behalf of the Board for the very cordial welcome, and I feel sure that we shall get more than we can possibly expect in benefit from this meeting.

Now, ladies and gentlemen, I have the pleasure of introducing to you one who is no stranger to New England dairy methods, one who has worked in our neighboring State of Connecticut for the benefit of New England dairymen, and who will, I am sure, speak to you in a very interesting manner, Prof. J. M. Trueman of Storrs, Conn., who will address you upon "Heredity and the dairy cow."

HEREDITY AND THE DAIRY COW.

PROF. J. M. TRUEMAN, STORRS, CONN.

When I realize what a complex subject I have agreed to talk about, and think how little is definitely settled concerning it, I almost regret promising to undertake the task.

My excuse for appearing before you to discuss this subject is the fact that we are all deeply interested in everything that pertains to breeding the dairy cow.

Heredity is the "genetic relation between successive generations." [1] We are familiar with the proposition that all men are created free and equal, and yet Dr. C. B. Davenport in his recent book on "Heredity in Relation to Eugenics" says that "all men are created bound by their protoplasmic make-up and unequal in their powers and responsibilities." In other words, every animal born, whether man or beast, is made up of the characters of its ancestors. Heredity does not mean that a new independent organism has inherited certain characters from its parents, but means that the "organism and the inheritance are identical." Nothing new has been made; only the characters that belonged to the previous generations of that particular race have appeared in another individual. Thus we see that every organism, as Dr. Davenport says, is created bound by its protoplasmic make-up. It cannot free itself from the race to which it belongs.

This does not mean that every individual will be an exact reproduction of any one or two ancestors. Although no new characters are introduced, there is certainly a great diversity in the numbers that are present and in the proportions in

[1] Heredity, p. 6, J. Arthur Thompson.

which they are combined. In all the higher animals, at least, every individual brings together the characters of two separate individuals, and this combination will never be an exact reproduction of either one of the parents. In this way, we get a great diversity in families.

It might be supposed, however, that the successive offspring of any two individuals would all be exactly alike. This we know is not the case from every-day observation. Everywhere about us we see children from the same parents that are unlike in physical and mental constitution, and the same is true of the lower animals. This brings us to a brief consideration of the structure of the germ cells which produce the individual.

The microscope has revealed the fact that the cells of all living things are complex in their make-up. Without attempting to prove the statement at this time, it is sufficient for our purpose to say that the majority of scientists believe that the characters of the individuals are represented by actual physical factors in the germ cells; that is to say, if the animal is to possess horns, there is present in the germ cell a factor which causes horns to grow at the proper time, and the same is true for different colors, functions, etc.

Each of the parents possesses these various factors, and when they are joined together in the germ cells they do not blend into one factor made up of the qualities of both, but they exist together, as it were, side by side in a sort of partnership in which one factor may be dominant over another. For instance, if a pure, white-faced Hereford is bred to a pure polled Durham, which has a red face, the resultant offspring will have a white face.[1] The factor for red is there because the cells are there from the red-faced parent, but the red does not show in the offspring because in this partnership the white is dominant over the red. Why this is so we cannot tell; we only know that it is so by actual experiment. The red is not lost, however, because we find that if we breed the hybrids together, some of the offspring of this second generation will have red faces. This shows that the factors for red

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[1] For clear explanation of the Hereford-Durham cross, see article by J. W. Spillman in Vol. V., American Breeders' Association.

and white have not made a blend in hybrids, but have maintained their distinctive qualities. This is explained by the fact, discovered by Mendel in the middle of the last century, that when the reproductive cells are ready for fertilization they consist of only one set of factors; that is to say, any egg cell that is ready for fertilization may carry the red color or the white color, but not both. The partnership that has existed in the hybrid animals is broken up in the reproductive cells, and white and red are separate again as in the original pure-bred animals.

These reproductive cells that are ready to unite and form a new individual are called "gametes." The process by which the cell divides and arranges all these factors, so that no two that are antagonistic are found in any one gamete, is extremely interesting as well as complex.

Let us now see what will happen when the reproductive cells from this cross form gametes. Each complete cell will contain both red and white because the red Durham was bred to the white Hereford. As far as color is concerned, therefore, we may denote the constitution of the cell by WrK, making the r small because it is recessive, in that it disappears in the presence of white. When this cell divides, however, to form the marrying cells, or gametes, the white and the red separate and no gamete contains them both. This will be true for both egg and sperm cells, and the gametes containing white will be found in the same numbers as those containing red. When they are ready to unite there will be equal numbers of red and white gametes, and a red will have as good a chance of combining with a red as it will with a white, and the white will have as good a chance of combining with a white as with a red.

If numbers enough are used, therefore, the offspring will be pure reds or mixed reds and whites or pure whites. The mixed reds and whites will all show white faces because the white is dominant over the red. Therefore, there will be three whites to one red. The reds will all breed true to red if bred together, because the white has been lost out of their cells and they will breed as true as if they had never been

crossed with the whites. One-third of the whites will breed true to white, while the other two-thirds bred together will produce three whites to one red, exactly as did the first generation of hybrids.

This all shows clearly why the successive offspring of the same parents vary so much in character. The parents are producing a great variety of gametes, and the law of chance alone regulates the way in which they come together. If we consider the fact that gametes possess a large number of factors, and all of them are subject to the law we have been considering, we see at once that we will have an almost infinite number of kinds of individuals. For instance, suppose we add the factor for horns to the white-faced Hereford, and the factor for lack of horns (polled) to the red-faced Durhams. The gametes for the Hereford would be represented by H W and for the Durhams by P R. When brought together the resultant individual would be P H W R. When these cells divide to form gametes, the red of the Durhams will not be found in the same gamete with the white of the Hereford, but since red has no antipathy for a polled head or for one with horns, it may be found with either P or H, but not with both, because polled and horned cannot go together. The gametes will therefore have the constitution of P W or P R, and H W or H R. Now these are all produced in equal numbers, and so we may have animals produced composed of all the possible combinations of these four kinds of gametes. We may have P W P R, P W H W, P W H R, P R H R, H W H R, P W P W, P R P R, H W H W or H R H R.

When we consider that animals possess a great many characters presumably all represented by factors in the gametes, we realize the great number of possible combinations and consequently the great number of different gametes that will be formed. This explains, then, the fact so universally observed, that even successive offspring of the same parent differ greatly in their constitutional make-up.

I will not attempt to carry any farther at this time the

explanation of the way in which factors combine. Enough has been said to show that the transmission of characters from one generation to another is an orderly process, even if it is complex and hard to understand.

The dairy cow, as we see her, is the visible result of all these invisible processes that we have been discussing. We may judge somewhat of what has taken place in the cells of the parents by the characters visible in the mature cow. A study of her ancestors will tell us something more of what we may expect from her offspring. Galton, in England, reports the results of the study of a large number of Basset hounds.[1] From a careful record kept of the coat colors of these hounds it was found that the two immediate parents dominated in the color of one-half their offspring, that the grandparents dominated one-quarter, the great grandparents one-eighth, and so on. Of course this must be considered merely as a general law, and will work out only in practice, when large numbers are considered. Other factors, such as prepotency, vigor and dominance may modify the results.

As a working basis for determining the value of any particular ancestor it will be found approximately correct. For instance, if one ancestor in the great-grandparent row was possessed of exceptionally good qualities, what is the chance of these qualities appearing in the great-grandchildren? The two parents contribute 50 per cent, the 4 grandparents 25 per cent, and the 8 great-grandparents 12½ per cent of the general characters. Any one great-grandparent, therefore, will only contribute on the average one-eighth of 12½ per cent, or a little over 1½ per cent.

This gives a rather poor chance upon which to buy or select breeding stock. If all the ancestors are good, then the different generations may be added together, giving a chance for good offspring of 50 or 75 per cent, or even greater.

Even if we are given good sires and dams with which to work the offspring will not all be good. The back ancestors

[1] Proceedings of the Royal Society, LXI., 401-412.

have not all been as good as the immediate parents, and this fact will be a drag on the offspring. The pull of the back ancestors is called "regression" or the "drag of the race." Some of the offspring may be, and almost always will be, better than the parents, but the average of the offspring from parents much above the average of the race will be below the parents. The converse is also true, however; the average of the offspring from parents below the average of the race will be above their parents. The exceptionally good cow may have calves better than herself, but if she has many calves, the average of all their production will be below what she produces.

The only way to get rid of this "pull of the back ancestors" is to breed only animals that have a good ancestry. The farther back good animals go, and the smaller the number of poor ones found, the more often will the offspring prove valuable.

This means that, after all, we are brought back to the old rule, which says to breed only from those animals that have proved of exceptional merit.

It is possible that the scientist may discover some way of determining factors in the germcells and of combining gametes that will give us a guide to the number of animals of any one grade that may be expected from a particular mating. Dr. Raymond Pearl, of the University of Maine, states that he has a clue to the way in which the gametes are constituted in certain strains of fowls, and that he can predict a certain number of extremely valuable males from a given mating.[1] He has also worked out a scheme for picking out these valuable males that will undoubtedly prove of great value to the poultry breeders. Whether or not any such results can be obtained in the work with dairy cattle I am not prepared to say. It is probable, however, that in the near future we will know much better how to select and mate our animals because of the splendid work being done by trained investigators in various parts of the country.

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[1] Before the Poultry Association in Lansing, Mich., in June, 1912.

Mr. BURSLEY. Ladies and Gentlemen, we have Professor Trueman with us for another few minutes, and I am sure that he will be glad to explain any points which are not clear.

Professor TRUEMAN. In regard to the Jersey, let me say that the difficulty of explaining the big records in the past does not detract in any way from the magnificent records the Jerseys are making at the present time. The point I had in mind was that the argument that came to my mind was likely to have a hole knocked in it, and I hoped that I wasn't going to be caught up in the argument. As to the Jersey cow, you will all agree with me that I don't need to apologize for her in any way.

Mr. H. A. FORD. I would like to ask Professor Trueman, provided we had two good animals and couldn't well afford to buy another, how far he would recommend inbreeding.

Professor TRUEMAN. In answer to that question, you will find that there is no definite rule that you can go by; but so far as we are acquainted with the effects of inbreeding the only serious thing you are likely to get is lack of constitution. It all amounts to this; that one of the characteristics of our dairy cattle — in fact, of all animals, and it is true of our own race — is that we have to look out for lack of constitutional vigor, and therefore you find in your germ cells a great many individuals which lack vigor. Now, as soon as you begin to inbreed of course you begin to put double doses of it into that cell, because for the same animal you are breeding the same blood, and as soon as you begin to inbreed you begin to get double doses of the various factors, and if you have a factor in there which, in this case, might be a negative factor which meant lack of vigor, then the danger is that you may double that up. You may have connected with them the factor which calls for heavy milk production, as has happened, and you might have a great heavy cow which yet lacked vigor to reproduce itself strongly in its offspring. Therefore, I would put it this way as a practical proposition: Suppose I saw that my cattle were vigorous; for instance, I have a vigorous bull and the calves

that come from him are great big, strong, vigorous animals, and they have the qualities I want; then I should breed right back to those daughters. If the granddaughters from him, or the daughters, are vigorous, I would go right up that line and if they gave me what I wanted, personally I should breed again. That is to say, there is no reason against inbreeding in our animals except that you double up what you have, and if you have a good dairy quality that doubles up, and if you have lack of vigor that also may double up. Right here we come to the matter of fecundity. You remember a while ago there was a Shorthorn that sold in New York for $40,000 or over, and the fellow who owned that breed said it was a mighty good thing that those cattle were not prolific because they never could keep the breed up. The result was that in three or four years the race was gone. Absolutely the thing we must look after is fecundity in the production of offspring, and also vigor. Now, if you have those two things in your cattle you can keep right on inbreeding. The minute you see, — and here is where a man must be a skillful observer of breeding, — the minute you find your cows beginning to lack vigor, then you must go out and get a germ that has vigor to put in with it.

I would like to say one other thing in that connection which puzzles the scientists and is extremely interesting, to say the least, and that is that in plants and likewise in animals there seems to be a vigor from a cross of different bloods that is not always explainable by the vigor in the parents. I don't know why it is, I don't know that it has been worked out, and maybe it never will be, but it does seem to be inherent that in the living cells in some way there is an increased vigor from crossing different lines of blood. I don't know why it is, but it evidently is there for some reason.

Mr. H. G. Worth. I would like to ask Professor Trueman, in breeding the white-face male with the red-face poll, where he claims that the white-face predominates, what the effect would be if the red-face male were bred to the white-face poll?

Professor TRUEMAN. The same thing; it wouldn't make a bit of difference. In reciprocal markings you get the same thing. I say that off-hand and I am quite sure it is correct, as I have known it to be true in a great many cases. For instance, for the sweet pea, in the case of the red and white I know it is true, and I am quite positive it is true in this case. There are cases where the reciprocal marking does not work in the same way. The whole question of these gametes is an extremely interesting situation as to the male and female. Now, there are certain characteristics which you get right along in the male which you do not get in the female; that is to say, certain factors that are developed in the male gametes are repelled by the factors for the female, and so you get a whole list of complicated reactions in that way that are extremely interesting. I recommend to any of you who are interested in this problem to read Dr. Punnett, on "Mendelism." As I told you, Mendel discovered these truths, and they call it "Mendelism."

Mr. B. W. POTTER. I have sold a great many pedigrees. Now there are two ways of selling animals; you can sell the pedigree or you can sell the individual. I have always had the idea that if I were buying I would rather buy the individual, but a great many people seem to prefer the pedigree to the individual, and of course we have to conform to the wishes of our patrons in that regard. After hearing Professor Trueman, when he says that you are liable to get a double dose of lack of vigor in the cell if you inbreed, the question occurred to me, why wouldn't you be just as liable to get a double dose of vigor in the cell?

Professor TRUEMAN. You would.

Mr. POTTER. Well, how are you going to tell, then, when you should inbreed? You are simply in the position that you have to run your chances. We know that the things of this world are run by natural laws, but they are so indefinite that we are all the time feeling that we have to take our chances. Now the chances, as the professor says, are very remote in a calf, and I don't know that we can do anything different than what Emerson once said, "Hitch our

wagon to a star," and if we do that we may once in a while get a good animal.

Dr. R. W. Stimson. I was very much interested in this elaboration of the breeding problem, and I would like to ask Professor Trueman this question: I was attracted at the outset by his figures for the white face and the red face. He said, as I recall it, that if you breed the white face on the red poll, you get all white face the first generation. Then, if you breed a hybrid you get 25 per cent red face and 75 per cent white face. Now, supposing that you substitute "M" for "W," "M" meaning "milk," and "S," or whatever else you get, meaning "scrub." Can you figure in the second generation on 75 per cent fine milkers and 25 per cent scrub, or will you keep on and get the proposition of 25 per cent good stuff and 75 per cent pretty poor?

Professor Trueman. The only way I can get out of that question — and I guess that is what I will have to do — is just as the gentleman who spoke a moment ago said, that we would have to take our chances. But before I answer Professor Stimson's question that way, I don't want to leave the impression that it is all chance, because I am satisfied that the gentleman who spoke would make a good breeder and would have good stock, and has had it, by doing just what I said in the lecture, — selecting his breeding stock from good stock and having just as many good ones in the ancestry as he could get. Although we still must have the chances, understand, I would rather take the 75 per cent chance than the 25 per cent chance, and that is what it represents. If I don't look after the ancestry of the animals I am breeding, and take anything I can get, my chances are small. Now, if I am careful and do my selecting from good animals, then my chance is better, and the better the chance is the more careful I am in the selection of that offspring; so that although there is a chance, you understand, I would say that in one case the careless handling of the stock represents a 10 or 15 or 25 per cent chance in your favor, while the careful handling and selection represents a 50 or 60 or 75 per cent chance in your favor, which may mean all the

difference, and does mean all the difference between success and failure.

Now, on the other question, the reason that we cannot write into the gamete, evidently, a factor for milk and a factor for scrub is that the factor for milk probably is a half dozen factors; it is constitution; it is development of lungs; it is development of heart; it is capacity for food; digestion; the character of the udder; the size of the udder, — all these things go to make up the milk-producing factor, and I am satisfied that if there is any possible way, and there may be some day, — just as Dr. Pearl thinks he has found the factor which makes for heavy egg production, — I say that there may some day be found some way of isolating enough of these factors to give a fair idea of what we must expect. Dr. Pearl told me that he thought it would be possible, with the male, with the sire, to find the number and the individuals that had the double dose of the things we wanted, — to put it in that crude way, — by certain methods of inspection of the offspring, and calling attention to the fact that these great sires I spoke about a moment ago would be potent and mark themselves more strongly than any of the rest of their associates on their breed, and the race possibly could be explained in some such way as the male birds can be explained. But I think that the difficulty of getting at your 75 or 25 per cent is the number of factors that are involved.

SOME PHASES OF THE MILK PROBLEM IN NEW ENGLAND.

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I have been requested by your honorable secretary to discuss the milk question from the standpoint of the milk producer, the milk dealer and the milk consumer. To impartially and fully discuss the questions involved from the viewpoints of each of the three interested parties would be a most ambitious undertaking, and perhaps in no State in our Union would it be more difficult than here in Massachusetts. I therefore will not attempt to fully discuss the question from the standpoint of all interested parties, but will instead endeavor to discuss some phases of the question as I view it, and from the standpoint of one who, having observed conditions from various viewpoints — at close range and from a distance — believes in the ultimate solution of the problems involved on a fairly equitable business basis. Do not, however, think I have brought with me any personally prepared, perfected, patented plan for the immediate cure of all the ills, either natural or otherwise, incident to the production, distribution and use of milk. But rather let us together go over some of the problems involved, and together seek the means that may be employed in attempting their final solution. Some causes are, in my opinion, deep-seated and partially hidden, and are deeper and farther from the surface than the admittedly larger question of price received and paid for milk.

The Adaptability of New England Farms for Market Milk Production.

The ability and skill of a milk producer, whether consciously or unconsciously, is, to a certain extent, reflected in the quality of his herd and his ability to produce clean

milk economically. The tendency of the times is toward specialization, and this in milk production may or may not mean a smaller number of producing units, but it does mean producing units of greater efficiency and larger capacity. It may mean more or fewer cows, but it positively means better cows. It may mean more farms producing a larger quantity and better quality of milk, and it probably means fewer farms producing a comparatively poor quality of milk as a somewhat neglected side issue of a small general farming business. The business of milk production cannot forever and should not longer be held below a level that renders the sale of milk unprofitable when its production is well organized under fairly good management and on a strictly business basis, independent of *all* side issues.

The cow is necessarily the unit in milk production, which may be and sometimes is carried on independent of other farming operations; but as usually conducted, the herd should be considered as the home market for farm crops. The efficiency of every individual cow in the herd as a manufacturer of milk from farm crops must be known before her owner can justly claim to be a well-informed dairyman or a good business man. The cost of milk production is doubtless unnecessarily high on many farms, where loose business methods prevail and where positive information regarding the sources of profit and loss is not definitely known.

According to the best information obtainable, the smallest individual daily shipment of milk to Boston is one can of 8½ quarts. The largest shipment from a single farm is about 80 cans, or 680 quarts per day. The average shipment from the farms of New England is said to be about 6 cans, or very close to 50 quarts per day per farm. This, seemingly, is rather strong evidence that milk production is not at present, as a rule, carried on as an independent business along well defined business lines, and that but comparatively few milk producers are utilizing their whole time or executive ability in the business. Milk production, instead, seems to be largely a side issue, carried on in connection with general farming, which also is usually conducted on a rather small

scale in New England. When, however, we find, as we do, that the milk-producing capacity of a farm or herd averages only 50 quarts per day, and for this is required the used or unused time, attention, labor and business ability of at least one man and perhaps a part of his family, in addition to the use of money invested, we find a condition that, in my opinion, is responsible for much of the unrest of the past, as well as of the present day, among dairy farmers, whether producing milk for city markets or milk or cream for butter-making at the creameries. This condition is found not only here in New England, but also in many other sections as well, where dairying is carried on as a side issue rather than as a business. One of the slight variations in conditions in New England as compared with other sections seems to be found in the fact that figures generally credit the New England farmer with obtaining a little more milk per cow than do the farmers in other sections. An investigation of prices received by producers of milk for large cities made by the United States Department of Agriculture also indicates that the farmers of New England receive as much or a trifle more money for a given quantity of milk. As it is well understood that no cows and but very few milk dealers are philanthropists, these facts would seem to indicate that in spite of all difficulties and shortcomings the New England farmers, individually or collectively, possess the ability to get a little more milk from a cow, and, individually or collectively, a little more money from the buyers of milk, cream and butter, than do the producers supplying some of the other large cities. In spite of these facts, however, many farmers who are favorably located for dairying have, for one reason or another, been keeping fewer cows, and many who formerly produced market milk have stopped shipping milk to Boston. While I am well aware of the fact that the smallest producers of milk frequently make the most noise regarding their grievances, yet there seems to be some real difficulty which can be best expressed in the two words, "general dissatisfaction." This difficulty is apparently infectious, contagious, chronic and hereditary. It seems to have originated and been trans-

mitted from one milk producer to another in the years that have passed, and since then handed down through the succeeding generations. Sometimes this dissatisfaction seems to have been localized or confined to certain sections, and yet during the years of its existence, it has had its run in practically every neighborhood supplying the Boston market. Because of this general dissatisfaction hundreds and probably thousands have given up producing milk for market, but market milk production has been taken up by others and the difficulty has persisted, and now in an increasingly acute form it seems to have become more generalized throughout the whole milk-producing territory. To me, this condition is not, under the circumstances, at all surprising or unnatural, and while all will agree that the price paid for milk has been perhaps the most important factor, the present dissatisfaction is not, in my opinion, due wholly to the prices received or not received for dairy products. For many years agriculture in general in New England, and milk production in particular, whether for butter-making or for city consumption, has been regarded and commonly referred to by farmers as "ceaseless toil and drudgery," rather than as constant, steady employment; as "downright slavery, sixteen hours a day, week in and week out, with no break on Sunday," rather than as the daily preparation of a finished food product for a reliable cash market; as the "never a chance to get away for a few days so long as one is tied down to milking cows" argument, rather than considering one's self as the proprietor of a business, with no one else to dictate how it shall be managed.

Circumstances which cannot always be controlled often force people to engage in some line of work for which they have a positive and inborn dislike, for which in various ways they are eminently unfitted, and in which, regardless of their markets, they can never really succeed. This in the past has too frequently been the case among the rural population of New England, and in no small degree it has been and now is doubtless responsible for the unsatisfactory condition of affairs on many a New England farm. While attending a

State fair in New England a few years ago, I improved an opportunity which came to me to ask one hundred farmers, who visited the exhibit of which I was in charge, the question, "Are you interested in agriculture?" Of these hundred men, a half dozen replied that they were interested in agriculture, and gave me the impression that they were glad of it. A few more said they had a "little land," "did more or less at it," "were more or less interested," etc., but by far the great majority hung their head a little to one side or to the other, and as if pleading guilty to some disgraceful act of which they might have been accused, replied that they were "only farmers."

Seen or unseen, recognized or unrecognized, there is usually a cause for every condition. For years New England farmers as a class have, regardless of their degree of financial prosperity, persistently condemned their business, and directly or indirectly they have influenced and interested their children in leaving the farm for the city, or in leaving the east for the west. Generation after generation of boys have listened to such arguments and have left the farms of New England, and the losses which New England agriculture has suffered as a result can never be fully realized or measured. Their going has forced farming values to a lower level than land of equal producing power is valued in any other section of the United States; and as a practical proof of this assertion, we have only to refer to the fact that nowhere in this country to-day are such bargains in desirable farming lands to be found as right here in New England and close to New England markets. Because they have never been taught to appreciate farm life with its opportunities and advantages, farm boys and girls of New England have in too many instances become city consumers of milk rather than milk producers, and the time is close at hand when they must be brought face to face with the plain truth, and learn that they cannot go on forever with their present plan of taking from 15 to 20 cents in food value in every quart of milk from the farms of New England, and only giving in return from one-half to two-thirds of its real value.

That the general problem involved is far-reaching, and is not confined to the New England farms producing milk for the city markets alone, has been shown in several instances. As regards the question of price received for dairy products, perhaps in no instance has it been more clearly shown than in the investigation of expenditures and receipts of those New England farms producing milk and cream for the manufacture of butter for the New England creameries. This investigation, carried on by a well-known and reliable dairy paper, found, among the 100 herds investigated in Vermont, only 32 that were kept at a profit to their owners, while 68 were kept at an actual financial loss. Of the 100 herds investigated in New Hampshire, the cows in 60 herds were kept at a loss, and but 40 herds returned a financial profit; and wherever similar investigations have been carried on it has been pretty clearly demonstrated that a large proportion of farmers, whether marketing their products in co-operative creameries or selling milk for city consumption, carry on the dairying branch or department of their business at an apparent financial loss. Probably no other business offers more difficulties when it comes to keeping exact accounts of expenditures and receipts; but wherever this has been honestly attempted and carried out for a number of years, dairymen have invariably gained the knowledge necessary to enable them to conduct their business in a profitable rather than in an unprofitable way. It is a significant fact, both in New England and elsewhere, and regardless of the form in which they market their dairy products, that the real dairymen who are keeping records of their individual cows, who are breeding for improved stock, and who keep posted regarding the development of the dairy industry, are almost without exception successful from a financial standpoint. On the other hand, those men who have the smallest regard for the advancement made in agricultural science and education, who most frequently laugh at the suggestion of breeding for better cows, keeping records of production, feeding balanced rations, or in other ways attempting to reduce the cost of production, are usually the ones who make the most

noise, and regardless of the price received for milk or butter are very positive that it is altogether too low. They are like fettered men in a ship in mid-ocean, who can only gaze on the sun or the north star — which represents the price received — and cry aloud in their despair, because they evidently have not possessed the necessary initiative, the resourcefulness or power, to break the bonds or habits that bind them, turn their craft about, battle with the waves, and steer a straight course for land and a lower cost of production.

The period of agricultural depression which New England has suffered for many years and which still lingers in many places is a difficulty which demands the skilful treatment of specialists for a series of years, rather than a patented proprietary medicine promising instant relief. The public schools can and should be used as a starting point, to establish in the minds of the children a healthy interest in country life and its advantages. It is there that influences other than home influences can first be set at work to correct inherited tendencies, and the work there begun can, to some extent at least, be followed up through the agencies of the agricultural schools and colleges, agricultural and dairy associations, and through agricultural and dairy publications. In an address delivered by President Butterfield in a neighboring New England State several years ago, he expressed the opinion that "If the granges of New England are ever permitted to degenerate into mere social organizations, one of the grandest opportunities for the real advancement of New England agriculture will have been lost." To what extent the granges of New England have improved, are now improving, or may be able to improve their opportunities to make farm life attractive and financially profitable is a question which possibly they may do well to more seriously consider.

Under competent leadership — and in my opinion, New England needs nothing to-day so much as it needs strong, competent, active leadership in agriculture — these established institutions above referred to, and possibly others as well, can be made really effective agencies by which, and through which, the whole truth can be determined, plainly

presented, and finally established in the minds of all the people. In the light of actual facts properly presented, and positive information regarding the sources of profit and loss in farming and in milk production, misinformation, distrust, prejudice, and general dissatisfaction must of necessity eventually disappear, and a more intelligent, intensive and profitable agriculture gradually become established in New England. Until the milk producers of New England are able to present positive, definite information regarding the cost of milk production with a fairly well-managed herd, their arguments for an increased price, however deserving, eloquent or just, will, to a certain extent, lack the strength that carries full conviction. But just so soon as the producers and dealers can *clearly* show a good and legitimate reason why milk should and must be sold at a higher price to the city consumer, just so soon will the city consumers pay that price.

Collection, Handling and Delivery of Milk.

If I am correctly informed, the city of Boston had grown so large in the year 1845 as to attract the attention of a New Hampshire farmer as a desirable market, and at that time the first use of steam railroads in shipping milk to the city was made. Finding a profitable market for his product beyond the capacity of his farm, he later bought milk from his neighbors to sell to the neighbors of his city customers. And so the plan for supplying Boston with milk has been carried on, enlarged, and developed by this man and by others for a period of sixty-seven years. As the demands of Boston milk consumers and those of other nearby cities increased, so also has the number of farms supplying Boston with milk. Those in authority tell us that at present within a radius of about 270 miles of Boston, there are about 7,000 farms, located in New England and New York, that regularly contribute to the general milk supply. It would seem that the territory from which Boston's milk supply can best be secured is now pretty fully covered by the various milk contractors, and that instead of reaching out into other and more distant

territory for additional supplies, as has been possible in the past, the time is at hand when the contractors will naturally have to look more closely after the development of the territory in which they are now doing more or less business, for the increasing demands of the constantly growing cities. If in the producing territory now practically covered there shall not eventually be found a sufficient number of farmers or dairymen who will produce milk at substantially present prices, then the buyers of milk will naturally, according to the laws of business and of supply and demand, be again obliged, as they have been in the years that are past, to pay more for it.

The collection of milk in the country, its transportation, handling and delivery to the city consumer is a business made necessary by modern conditions of civilization. So far as the present plan for collecting and protecting Boston's milk supply in transit is concerned, there is apparently but little left to be desired. So far as I know, there is little or nothing that can be profitably copied from other places that is so well adapted for New England conditions, or that will to any extent improve the system now in use. So far as the general milk supply is concerned, the dealers should exert, and I understand several are exerting, the strongest efforts to secure the cleanest possible supply, and to handle it in well-appointed buildings especially adapted to the purpose. As an additional precaution and safeguard I understand they are employing modern methods of pasteurization to insure its absolute safety for all possible uses. The principle of payment according to quality is right, and easy of practical accomplishment with most products. The principle when applied to the purchase of milk, however, presents some rather unusual difficulties so far as it relates to the general milk supply. So far as the problems of distribution of milk to the city consumer are concerned, they have been for many years well recognized and understood by at least a few intelligent people; but no one has yet become so intelligent as to be able to present a better working plan than that now generally followed. Glass bottles are by far the best and

most generally used container for delivery to family trade. Several dealers' delivery routes may cover the entire territory, and others only a portion of it, and the duplication of routes in the milk delivery service is necessarily a source of expense. This duplication of expense is not confined to the milk business alone, however, but is found in many other lines of business and in social life as well. When we have a plan for the satisfactory arrangement of the number of churches that can be most economically maintained, and so arrange the minds of the people to the extent that all people on certain city blocks shall worship at a certain church located most conveniently to their place of residence, regardless of their former belief, and when we have people who will be of one mind as to the place where they will buy their clothing, shoes, groceries and market supplies, we can also have a condition of mind that will enable all the people on certain city blocks to unite in buying their entire milk supply of a single dealer, and pay their milk bill when it is due. Frankly, I do not believe it would be possible for either the city governments or the producers of milk themselves to carry on the business of buying, handling and distributing milk more economically or with greater regard for the public health than it is now being carried on by some of the larger, more intelligent and progressive dealers.

These are some of the problems which, I believe, the present generation unfortunately may be compelled to leave for future generations to solve. In order, however, that there may be future generations which will be capable of solving some of the problems which we may be compelled to abandon, it will be wise and necessary that we, in this day and generation, should seek a proper understanding regarding the relation of the milk supply to the public health, and the importance of a safe milk supply from

The City Consumer's Standpoint.

The production, distribution and use of milk is, first of all, a business proposition. The composition of milk is not a matter of public health, but is a matter regarding which

the city consumers are not in a position to judge or to act intelligently in protecting themselves; and so they must, instead, be protected by the city or the State. The production, transportation, distribution and use of milk becomes a matter of concern for the health authorities only when it is evident that the methods employed in the milk industry are such that the public health is likely to suffer. Because of this more or less apparent danger, most supplies are now regulated to some extent, and probably should be regulated to an even greater extent, by city or State laws, enforced by health authorities and dairy inspectors appointed for the purpose. There are those possessing business ability who may grow their corn or potatoes, who may raise their beef, pork and poultry products, fruits or vegetables, and those who may buy and sell these products, but who, because of their natural disregard of cleanliness in all its details should never for a moment be permitted to engage in the production or handling of milk or cream. This business is in itself a particular business for particular, careful people, and those, and those only, who know what real cleanliness is, and how it may be secured and maintained, should ever have been permitted or should now be permitted to engage in or to continue in any part of the work.

Each consumer uses on an average about two-thirds of a pint of milk daily. Between 60 and 80 per cent of all babies are, during a part of their first eighteen months in this world, entirely dependent on cows' milk in some form. These plain facts, considered in connection with the fact that many adults are at times almost equally dependent, quickly brings us to a realization that without cows' milk, we, as a people, could not long continue to exist. Not only has milk become an invaluable and indispensable factor in the rearing of children as above indicated, but pure milk is also gradually and slowly coming to be understood and appreciated as one of the most economical and nourishing of all foods for general family use. In addition to the lives actually saved by the timely and careful use of milk, we must also consider the great and immeasurable service which

it renders in nourishing the weak and increasing their powers of resistance to disease, and in building up strong, vigorous, healthy men and women.

Occupying, as milk does, such a unique place as a universal economical and nourishing food for the human family, and dependent upon it as we are, we must then recognize in pure milk the most indispensable of all food factors for the perpetuation, nourishment and physical upbuilding of the human race.

It is only when milk is produced by diseased or filthy cows, or under filthy conditions, or handled by dirty or diseased people, or kept for a long time at high temperature, or neglected or misused in the homes of the consumers, that it becomes unsafe or dangerous. In comparatively rare instances there have been outbreaks of diseases following the use of milk containing the germs of disease, which in some way had been conveyed to the milk from the body of some person or animal so affected. In other instances intestinal disorders have followed the use of milk containing stable dirt or other foreign and filthy substances. Perhaps in the production and handling of no other food product is cleanliness more to be desired or more difficult to secure, and in no other food product is the absence of cleanliness or the practice of deception more dangerous and at the same time more difficult to detect.

The city housewife does not buy partially decayed fruit or vegetables for the family without a knowledge of its real condition, but she cannot judge for herself the composition or cleanliness of the milk she is to buy for her baby, or whether it was produced by healthy or diseased cows, handled by clean, healthy, careful, honest people, or by people whose habits are the very opposite. It is for this reason that competent, active, sensible inspectors for the dairy farm, the city milk plant, and the milk supply itself are a present-day necessity in every city; for the health of the people should be protected by the city or by the State when the people individually have neither the time nor facilities, or perhaps the degree of intelligence, necessary to

protect themselves. Our standards of cleanliness as a people are in these days being raised to and established on a higher plane. These changes are primarily due to the fact that the scientist in his laboratory, equipped with modern appliances and with a knowledge of modern methods of laboratory procedure, has, during the past few years, been studying and developing the comparatively new science of bacteriology. He has been finding out why and how things happen. He has discovered some important facts relating to milk supplies, the relation of germ life to milk, and, through milk acting as a carrier of germ life, the relation of the milk supply to disease.

As a result of the development of the science of bacteriology we, in these days may have, if we will, a very definite knowledge of germ life and its relation to milk, and to disease, that was not possible for our grandfathers or for many of our fathers. We are now approaching the time when cleanliness in dairy work, as in some other lines of work, will no longer be a matter of personal opinion, — with each individual having a standard of his own that suits his own convenience, — but where instead cleanliness will be a measurable condition and a matter of fact as established by laboratory processes. A thorough study of market milk conditions as they actually exist is to be urged, and this applies to milk producers, dealers and consumers, to health officials, dairy inspectors and particularly to practicing physicians, whose peculiar influence in the homes of the people is far-reaching. When each fully appreciates and understands the problems of the other, the producers and dealers will recognize and understand the reasonableness of most health requirements relating to the milk supply, and health officers and inspectors will realize that educational work should in most cases precede the exercise of police powers, and that a reasonable time should be allowed producers and dealers for the improvement of the milk supplies. Then, too, consumers of milk will find upon investigation that in buying milk at the prevailing prices they are securing food values for about 50 cents that if purchased in other desirable forms

would cost nearly or quite $1. If, in addition to the cost of feeding cows and caring for them and their products in a very ordinary way, there should be added the cost of cleanliness of healthy cows, proper equipment and clean methods, who can justly complain?

Fortunately, the price of cleanliness plus the bare cost of production and distribution need not be so great as to impose any hardship on the consumer. He may not then, as now, when he buys milk, be able to get a full dollar's worth of food material for 50 cents, but he will be able to buy milk, and clean, safe milk, too, at bargain prices.

Fundamentally, there is no good reason why the milk problem from the sandpoint of the producer, the dealer and the consumer should not be solved in a practical way and on an equitable basis, for so long as the actual food value of milk that can be purchased for a given sum remains higher than that of most foods, just so long will there be an opportunity to meet an increased cost of production, and, from a sanitary standpoint, to improve the supply without undue hardship to the ultimate consumer.

Mr. Smith. The subject is now open for discussion.

Mr. George Albree. I desire to have a personal word with the members of the Board of Agriculture. You are doubtless aware that a meeting was called on the 25th of September by the Boston board of health for the purpose of arranging some plan by which the milk producer in New England could come directly in contact with the consumer. Having given the matter some considerable thought, I was induced to make a proposition to the mayor of Boston for two reasons: first, that my dairy might be re-established; and second, to assist in the solution of that great question. My proposition was, first, to determine as to whether or not this much-mooted question of purity cut any figure at all, so far as the consumer was concerned, in influencing the price which he or she might be willing to pay for milk. I therefore made some self-imposed conditions which I believe will never be imposed by any regulating board in Massachusetts.

I agreed, first, to produce milk under such rules and regulations as might be imposed by the State Board of Health acting in conjunction with the city Board of Health. Second, I agreed to have every cow tuberculin-tested by the State Cattle Department before she became a producer in the herd, and keep the herd under the supervision of that department. I agreed to deliver that milk f. o. b. in Boston at 5 cents a quart. From figures of the operation of my barn for a number of years, I was perfectly willing to undertake the proposition, and at the conclusion of the period, or at the end of each month, submit a detailed statement, showing what the cost of production had been on my farm. After two months I have not had an application for a pint of milk from the city of Boston, from either consumers, contractors or individual dealers who are financially responsible.

In view of this positive evidence that I agreed to deliver this quality of milk at 5 cents per quart, and still stand ready to do just that thing, I could find no market for it. Now, I submit that if they will not pay 5 cents, what are they willing to pay for such a product? I want to say that my observations and investigations lead me to but one conclusion, and that is this: that those who control the Boston milk supply to-day — the dealers — are doing just what every business man will do, and that is, buy milk where they can buy it cheapest; and the Massachusetts dairy is suffering for the reason that the dealer is buying and can buy, so long as present conditions obtain, milk cheaper in New York, in Canada, in Northern New Hampshire, Northern Vermont and in Maine than in Massachusetts.

Why can he do that? It is a question of transportation; it can be nothing else. The contractors have imposed upon the producers a price, not at which it can be produced profitably, but the lowest price which can be paid and still insure its production. As long as that commercial condition exists, the market and the demand will be for milk produced outside of Massachusetts, and Massachusetts farms will continue to abolish the cow and let their stanchions stand idle. Therefore, if I may at this time direct the attention of the

Board of Agriculture, Mr. Chairman, and that of the federal government, through Mr. Weld, to that important commercial question and ask you to solve it, I believe that then you will have taken the first step to solve for all time the question of the restoration of the dairy farm in Massachusetts.

Now, is the present condition favorable to the dairies outside of Massachusetts? To answer that question I want to say this, that while I was selling D. Whiting & Sons a 20-cent cream for $1.75, 8½ quarts at about 20 cents a quart, Mr. Whiting told me that he was paying me $1.75 per can for what so far as fat contents was concerned, was exactly the same as could be bought in the State of Maine for 76 cents. I spent nearly ten days in Maine looking up that proposition and I found that it was absolutely so, and the only reason he took the small product from my farm at that time and at that price was in order to have it sustain a cream which he could put out to the more particular trade until the trouble was past.

I therefore believe that the condition of affairs which I have tried in this short time to drive home to the members of the Board indicates that the solution of this question is purely the solution of the commercial, mercantile question, to work out the salvation of the Massachusetts dairymen.

Mr. R. B. Baker. I would like to ask the last speaker if he doesn't consider that sanitary milk can be produced in this State and marketed at 50 cents a can, which I believe he said he was receiving?

Mr. Albree. To specifically answer the gentleman's question: I am willing to undertake to make sanitary milk at a profit at that price, and under reasonable conditions to be imposed by the State Board of Health and the city Board of Health, acting in conjunction. If you ask me to produce Jersey and Guernsey milk of that quality at 50 cents a can, I won't do it.

Secretary Ellsworth. I have a word to say in regard to the paper, Mr. Weld. That paper brought out clearly two points: the first was that the milk business ought to be carried on on a business basis, — that it is a business in itself;

the second point was that the public do not appreciate the value of milk, although it has been published and talked about a great deal, and possibly it is for this reason: they are not going to pay any more than they are obliged to; just as long as they can get milk that is satisfactory at a low figure they won't pay any more. That is perfectly natural, but the time is coming, and before many years, too, when the farmers who are in the dairy business, if they continue in it, — and it is a question whether they will not get discouraged, as Mr. Albree did, and go out of business, — will get all their milk is worth, for the time is not very far distant, I believe, when there will be a scarcity of milk, — a famine in milk. This is not only true in Massachusetts but in many other States. Cows are growing fewer, the profits of the dairy business are smaller, and the demand for clean, pure milk is growing greater right along. It is right, if they pay for it, that they should have it, and I believe the matter will be straightened out in the course of a few years and the dairyman will get his reward. I would like to ask Mr. Weld if that matter of the scarcity of cows and the general unrest among the dairymen isn't a fact, perhaps, all through the United States?

Mr. Weld. The Secretary has asked an interesting question regarding the comparative number of cows. Just before leaving Washington the idea occurred to me that there might be some interesting figures along those lines, and so I consulted one of the latest authorities, and here are some figures: in the year 1900, it is estimated that there were 16,292,000 cows in the United States; five years later, 17,500,000; in 1910, or ten years later, 21,801,000; in 1911, 20,823,000. You see, by consulting these figures, that the year 1910 showed a larger number of milch cows in the United States than any previous year or any year since that time, the year 1911 showing a decrease of practically 1,000,000. For the year 1912 it is substantially the same as 1911, but what difference there was in the year 1912 showed a decrease of substantially 224,000 cows over 1911. It would seem that the height of the dairy business, so far as the milch cow was

concerned, was reached in 1910, and that since that time there has been an apparent decline, taking the United States as a whole. Now, then, in New England the figures indicate substantially the same number in Maine; practically the same number in New Hampshire, a slight decrease, however; an increase in Vermont; a decrease in Massachusetts; substantially the same number in Rhode Island; a slight decrease in Connecticut. There was also a decrease in New York, in New Jersey and in Pennsylvania. It may be said that the conditions in Massachusetts are typical of the conditions which exist in other places, so far as the reduction in the number of milch cows is concerned. If we consider the States of the Union in which there has been a decrease in the number of milch cows during the past year, we will find that those States include not only the States I have mentioned, but Virginia, West Virginia, Ohio, Indiana, Illinois, Iowa, Minnesota, South Dakota, Texas, Kansas, Kentucky, Tennessee, Oklahoma, Arkansas and California. The State of Washington showed a decided increase, but you will see that there is a total of 21 States in the Union where the number of cows has decreased during the past year. To that extent, Mr. Secretary, the conditions are not different in Massachusetts than they are in other milk-producing sections.

There is one difference which impresses me to some extent, however. I have come in contact with many dairymen in the Virginia and Maryland districts who are producing milk for Washington, and although the number of cows in Virginia showed a sharp decline during the past two years, yet it is a very rare thing to hear a milk producer in Virginia condemning the business of market milk production. A decrease in the number of cows has taken place in territory which supplies such markets as Norfolk and Richmond, where the producers of milk have been retailing their own product to consumers at 10 cents per quart; it has also taken place in producing territory adjacent to Washington, where the producers of milk received substantially very close to 5 cents per quart by the year, delivered in Washington. This decline has taken place in Virginia under conditions which are

somewhat more favorable than they are here in Massachusetts. I do not believe that the question of price is wholly responsible for the apparent decline. I believe it is the unrest among the farming population, a desire to get away from milking cows, to do something else. The question of price may be, and probably is, in part responsible, but I maintain that it is not wholly responsible; there are these other influences back of that, and the general tendency and desire is to get away from farming operations.

Mr. P. M. Harwood. Don't you think that the fact that it hasn't been profitable is the reason for this unrest?

Mr. Smith. We would like to hear from Mr. Harwood.

Mr. Harwood. Mr. Chairman and Gentlemen: I didn't expect to be called upon, but I asked the question because, as the speaker has said, there is unrest. To my mind the main reason for this is the fact that a given amount of nutrition in the form of milk sells for less than it does in any other form of animal food, where the nutritive ratio is the same and the digestibility is the same. Make the milk business profitable and people will engage in it. People are not going to be satisfied with any condition where circumstances do not assure a fair profit.

The matter of transportation has been brought up. Now if something could be done whereby the present unsatisfactory transportation conditions could be rectified, would it not be possible even then for Canadian, northern Vermont, northern New Hampshire and eastern Maine farmers to produce milk and place it upon the Boston market for less than can be done by Massachusetts producers, even after the long-haul transportation charges are added? I don't believe, important as the transportation question is, that this would solve the whole question. Education is necessary, and I know that the people of Massachusetts are hungry for it. The State Board of Agriculture recently issued a small edition of a pamphlet on the "Food Value of Milk." It was not two weeks before it was all gone and a call for a new edition of 25,000 copies was given, and the greater part of that edition is already distributed. Consumers are learning

the food value of milk, and I believe when they thoroughly understand it they will be willing to pay a fair price. The largest milk producer in this State, so far as I know, told me within six months that he could double his business, and he gets 12 cents a quart for milk of 4 per cent or better quality. Milk bringing this price must be near-by milk of superior quality. Our producers cannot longer expect to successfully compete on even terms with ordinary long-hauled milk, which comes from 100 or more miles outside of the State and is produced under cheaper conditions.

Mr. H. A. Parsons. I don't want to take issue with Mr. Harwood, but I certainly agree with what Mr. Weld said. I think the unrest is due to the fact that people won't be tied down to milking cows, as he contends. We have a lot of Poles, but you can't get them to milk cows; they won't be tied down.

Mr. B. W. Potter. While sitting here I thought of one or two suggestions I should like to make. I think that the public is in a state of mind to give the farmers of Massachusetts about any law they want, provided it is reasonable. It seems to me that the State Board, or the committee on transportation of this Board, should call a conference of the milk producers and consumers and other interested people, and see if they couldn't agree upon something that would be fair and reasonable and that could be easily placed upon the statute books.

I have some suggestions to make on the point where the speaker has undertaken to attribute the depreciation of the milk industry to the fact that the farmers themselves are dissatisfied and instruct their children to leave the farm. It is a commercial question, a question of the great law of demand and supply and of the market, which is superior to any law you can make. When you come down to the question of the market you have got to adapt yourself to the market and make conditions such that they are satisfactory. I often hear people say that if the farmers of the present day would live the way their fathers did or like the Polanders live, they could make money; but is there any reason in the world

why the farmer should live like Polanders any more than the merchant or the manufacturer? Almost every farmer I know is proud to be a farmer. There is nothing unpopular about it, the only question is, is it profitable? Now, the unprofitable kinds of business always seek the profitable kind, and the latter draw help and draw business from the unprosperous business. Now, if conditions were such that every man could get a good living at farming, everybody would be in the business. They all admit it is a pleasant business and a healthful business, and that there is no business in the world so independent as farming; and if as good a living could be made on the farm as elsewhere we would not have to talk about educating people to go back to the land, and all that sort of thing; they would go there by the natural law of the commercial world.

One of our chief difficulties is in regard to the help question. Mr. Parsons says that the Poles won't even milk. Now, that isn't a disagreeable thing to do; you can do that and be thinking about something else. If these Poles were paid as much as they were paid in the factories and other places they would just as soon milk cows as do anything else. If the farming business was profitable, so that we could pay our help as much as they get in other occupations, we would have no trouble in getting help.

The speaker says that the farmer who doesn't keep accounts is going out of business. The reverse of that is true; it is the man who does keep records that goes out of business. It is they who think they are making a profit when they are really making a loss who stay in the business.

I think, however, that the most important thing is that we get together upon this transportation question. It is an outrage upon Massachusetts for any railroad to go into the northern part of New York or go to Canada or Northern Vermont or way down in Maine and ship milk in from there and charge no more for transporting the same quantities for that vast distance than they do for 30 or 40 miles out here in Massachusetts. We can control that matter if we want to, and if we try to, and it is the duty of us as farmers

and of the Board of Agriculture, to do something to relieve present conditions. We have a right to insist that the railroad shall make a rate proportionate to the distance, and we must compete with producers of other States or go out of the business.

Mr. L. H. Ruggles. Mr. Chairman: I have been very much interested in the discussions here. I think the low price received for milk and the high cost of production are the causes of so much unrest in the business, and as soon as the price of milk is raised to such a point that the producer can afford to pay responsible laborers there will be no trouble in hiring help and in going on with the milk business. I believe that when that time comes the farmers will again take an interest in the business. They can't do it unless there is profit in the business.

Mr. R. B. Baker. I want to say just a few words in regard to the price of milk. I believe that there is money in producing a sanitary 4 per cent milk at 50 cents a can. My experience is that you can get just as large a price for the 4 per cent milk as for the 5. What the people in Boston want is a good quality drinking milk, and for that they are willing to pay a good price. They are not willing to pay a good price for milk that comes from Canada and Maine and New Hampshire, because it is too long on the journey.

I am able to sell my milk in Boston for between 50 and 67 cents a can, and I can sell all that I can make. I guarantee it to be 4 per cent milk, and I guarantee the bacteria count to be under 50,000, and I guarantee the cows tuberculin tested. Any farmer can do these things. I have no fancy farm, but just a good, ordinary barn. I could sell three times as much milk if I could make it, and I find there is a profit in it at those prices. Neither the price I get nor the milk I make are unusual; it is just ordinary milk that any farmer can produce. I am 12 miles out from Boston, and I think that anybody living where milk can be delivered fresh can get that price and find plenty of people to buy it. I would say that the milk I get 67 cents a can for I have to pay 10 cents to transport, making it net me 57 cents; the 50-cent milk is net.

Mr. P. M. Harwood. I am glad the gentleman spoke as he did, for it exactly bears out the argument which I have presented here, and you will notice that he is getting practically 7 cents a quart for his milk at wholesale. Other farmers in Massachusetts ought also to be able to do this. Then the industry will be placed on a sound basis and all will be as happy as Mr. Baker.

Mr. John J. Erwin. My experience in selling milk to the contractors is that they won't stop the car where I live in Wayland; they say they don't want any milk from a place so close to Boston.

Mr. A. W. Bartlett. I had the pleasure last year in the Legislature of fighting what was called the Milk Consumers' Association, and it was said at the time of the hearing before the committee that there were no consumers present, that the consumers were simply represented by one man, or by counsel. Now, it was my privilege to work against the putting of the farmers in a position to be sentenced to jail for doing something which they could not know, at the time they were sending their milk to market, that they were doing. I want to say that I am a milk producer. I keep a herd of 20 cows, and I can see that the State Board of Agriculture ought to take hold of this question of transportation, so that Massachusetts should not pay 7 cents a can to get her milk to market when Canada can get it here for 5; and as a member of the Board, I am willing to do anything that I can along that line.

Evening Session.

Secretary Ellsworth. It is my pleasure to introduce to you this evening Mr. R. H. Race of North Egremont, who represents the Housatonic Agricultural Society, which always holds such a successful fair at Great Barrington. Mr. Race.

Mr. R. H. Race. Mr. Secretary and Fellow Members of the Board, Ladies and Gentlemen: It gives me great pleasure to stand before you and look into your faces, and I was wondering, as I sat here, why it is that I am up here when other men whom I always used to sit in the back seat and

look up to are present from all sections of the State. I have the pleasure of introducing to you to-night, as the speaker of the evening, a professor from Ohio, and I introduce him with a double pleasure, because he is a representative of the Dairy Association in this country, and because he is from Holland, my native country across the sea. It gives me great pleasure to introduce to you this evening Prof. Oscar Erf, who will lecture to you on "Dairying an important factor in agriculture, as demonstrated in European countries."

DAIRYING AN IMPORTANT FACTOR IN AGRICULTURE, AS DEMONSTRATED IN EUROPEAN COUNTRIES.

PROF. OSCAR ERF, OHIO STATE UNIVERSITY, COLUMBUS, OHIO.

Experience has proven to be the best demonstrator of facts in agricultural vocations. Time is required to prove these facts. While science has made rapid strides, it has advanced along lines in which results can readily be secured. Our country is becoming more densely populated, the area of new lands with virgin fertility is limited, and the fertility of the old lands is gradually becoming exhausted. Our country is facing the conditions that the European countries have met in the past. It is a great economical problem that we have before us, and the experience of other countries may aid us in its solution.

Those specializing in different lines of agriculture are likely to have narrow visions, and we do not mean to state that dairying is entirely responsible for the great development of agriculture in European countries, but it is our desire to impress the fact strongly that dairy farming is a very important factor in their progress.

England, Germany, France, Norway, Sweden and the smaller countries, like Denmark, Holland, Belgium, Switzerland and northern Italy, show most plainly the prominence of dairying in their systems of agriculture. The most densely populated country of Europe is probably Holland, which supports about 490 people per square mile, in comparison to our 34. Flowers might be considered the most important crop there, and the gross receipts would indicate that to be the fact. But upon a careful study of the situation we find the cow to be a necessary adjunct to the business of growing flowers. It is the cow who makes the lands fertile

and productive, and at the same time pays for her feed and care by producing food for mankind. We have similar conditions in some portions of this country, but instead of the intensive culture of flowers, we make use of the fertility for food plants, such as wheat, corn, oats and other grains, which do not return as large gross receipts from the same area. The people of Holland make their living chiefly from the soil, but they buy much of their grain from our country. It must, however, be borne in mind that grain is fed to their animals in very limited quantities. Roots, grass and hay are the important feeds of the dairy cow there. These, of course, are raised on their soil. By this intensive system of agriculture the value of the land is greatly increased, so that in many parts of Holland land is worth $2,000 per acre, and in some parts as high as $2,500 per acre.

We find similar conditions on the islands of Jersey and Guernsey. The Isle of Guernsey is 12 miles square and supports a population of 40,000 people. The same general conditions exist here as in Holland. Both make dairying the chief factor in their agricultural pursuits.

Denmark is considered one of the most intensely dairy countries of Europe. The history of its development well illustrates the part that dairying has played in its progress. After the war with Germany, by which Denmark lost its very important possessions, namely, Schleswig-Holstein, a most fertile country, Denmark became a bankrupt country with an extremely high tax rate. It was a bleak and wind-swept land with a practically barren soil. Previous to the war it was largely a beef-producing country and few dairy cows were kept. On account of the high tax rate necessary to pay the debt created by the war, and the tax put upon the meat importations from England, Denmark was obliged to resort to a more intensive system of farming. It is a common saying that "Necessity is the mother of invention," and it was not long until, through practical experience, they found that dairying was their method of salvation. Feed was purchased from other countries and fed to the dairy cows. Their soil became fertile. Mineral fertilizers were

purchased in limited quantities, and schemes for securing more productive cows were introduced. The increase in production was an extremely important factor, and with very little expense this was increased 60 per cent by a scientific, systematic method of breeding and careful feeding. To-day, after forty years' experience with the dairy cow, Denmark offers the best solution of the economical problem of any country in the world. From a bankrupt country it has become the richest country per capita, in the world, and this has been accomplished chiefly through the instrumentality of the dairy cow.

Germany offers a similar example. Forty years ago it was a nation that imported 50 per cent of its foodstuffs, but by the introduction of dairy farming, notwithstanding an increase of 30 per cent in population, Germany has ceased to be a nation that imports its foodstuffs and has become a self-sustaining nation, its exports equaling its imports in value. Dairying would probably have been carried on to a greater extent were it not for the fact that rich fields of mineral fertilizers have been discovered within its territories. They have been able to supply large quantities of potash. Hence it has not become necessary to practice such intensive lines of agriculture as in countries having no natural resources.

Switzerland, being extremely mountainous, has some very fertile valleys, but these are limited in area. It supports a very dense population, and dairying plays a most important part in its system of agriculture. Swiss cheese is known the world over. In this mountainous country we find a striking example of individual labor, probably the best in the world. The noted Swiss watches are made by piece-work, chiefly by individuals in their homes, and the pieces are sold to a central factory. Swiss lace is made in the homes and sold to a company which exports it to other countries. Here dairying has made of the hillsides a veritable garden, and by its means, chiefly, the Swiss people gain a livelihood.

The same things might be said of France and Belgium. Ireland is making great strides in dairying. They have

changed their diet somewhat and have substituted in part milk, butter and cheese for the Irish potato. The introduction of dairying has had much to do with the prosperity of Ireland. The same is true in regard to Scotland, the home of the Ayrshire cow.

England presents a side of the subject that might repudiate some of the statements that have been previously made. England is known as a beef country, and this has played an important part in its system of agriculture. However, upon a close study of conditions there we find that 75 per cent of the land is in large estates with landed proprietors, many of them royalty, who use the estates, not for the purpose of establishing economical systems of agriculture, but simply for their own amusement. The remaining 25 per cent of the land in England is owned by the common people, and most of this land is farmed in an economical manner, and here, again, dairying plays an important part. Many of the proprietors of the large estates are supported by the tax from these lands.

We find in southern Italy a very poor class of people and a very general system of agriculture. Northern Italy is much more prosperous, and there we find up-to-date systems of farming, in which dairying plays not a small part.

Agriculture in Austria and in Russia, while developed very highly in some portions, on the whole is still in its infancy, and very little progress is shown along that line.

Recognizing the conditions in European countries, conclusions of much practical benefit to our own country may be drawn. If by the Danish system of farming a bankrupt country was made to be one of the most prosperous of the world, could not the same principles be applied in a beneficial manner in this country? With our tremendous resources we consume nearly 90 per cent of the total production of this country, and since there is an increase of about 20 per cent in population every decade, and a constant decrease in the production of agricultural products, it is very evident that the time has come for us to adopt more intensive systems of agriculture than in the past.

Dairying and other intensive systems of agriculture are being practiced to a considerable extent in some portions of our country, but there is room for great improvement even in those parts, and in many places no attempt is made to weed out the poor cows from the herd. The best systems of marketing are disregarded, and the agriculturist is not alert to the opportunities offered him. Considerable capital is involved in the dairy business, and there surely is no investment so staple and so safe as an investment in a farm.

If Germany by her systems of agriculture has been able to become a self-supporting nation in less than thirty-five years, would it not be desirable to put into practice some of her schemes, — introduce more dairying, organize more cow-testing associations and more breeding associations, have better roads, bring into practice the parcel post, — so that the products of the farm can be sent to the consumer at a very low rate for transportation, — and establish a credit system by which the farmers can borrow capital at a very low rate of interest. We should utilize and conserve the natural resources of the country and not allow it to go into the hands of large corporations. The underlying factors in the dairy operations are constructive rather than destructive, and it is the most conservative method of preserving the soil fertility that we have.

The dairy cow eats the grains and other feeds that are raised upon the farm and makes milk of them. At the same time, 90 per cent of the fertilizing constituents consumed by the average cow are returned to the soil in the shape of manure, which if properly applied is of great value; 10 per cent is used for the production of milk. We separate the milk and feed the skim milk to the calves, churn the cream and feed the buttermilk to the hogs, so that there is lost but an extremely small part of the fertilizing constituents, estimated to amount to about 36 cents for every ton of butter produced. Compare this with the enormous waste of fertility in grain farming. The loss of soil fertility with a ton of wheat amounts to from $8 to $8.50, and that with a ton of corn is from $6 to $6.50. The value of these grains

ranges from $40 to $60 per ton, while the value of a ton of butter is from $500 to $600. There is not another animal that furnishes as much fertility for our soils as the dairy cow.

The beef animal might be considered as playing an equally important part in the problem of economical farming, but let us compare the two. An average good cow produces 6,000 pounds of milk in a year, which contains from 12 to 12½ per cent of total solids, making from 700 to 800 pounds of kiln-dried foodstuff, which, without further preparation, can be easily assimilated and digested. Compare this with a beef cow that produces a calf each year, which with good care will weigh from 700 to 800 pounds at the end of the year. In dressing the carcass there is a loss of from 5 to 10 per cent. From 15 to 30 per cent is lost when the meat is cooked, and from 30 to 40 per cent of the remainder is refuse, such as bone, cartilage, etc. Only 150 to 180 pounds of actual edible food is left, and this contains from 35 to 40 per cent of water. Looking at it from an entirely economical standpoint the dairy cow is approximately seven or eight times more efficient as a producer than the beef cow.

It has been the aim of this article to give evidence of the importance of dairying in American agriculture. By a systematic and efficient practice of intensive dairying there is no reason why this country should not become the greatest agricultural country in the world.

Mr. Race. Professor Erf has presented a great many different thoughts. It seems as though it might be profitable to discuss this matter. Does any one wish to ask any questions?

Mr. Ivan C. Weld. Mr. President, I would like to ask Professor Erf if the people who are co-operating in Denmark through the cow-testing associations, and securing records of individual cows, have gone out of business as the result of such records?

Professor Erf. No; they have gone into the business. The point is this, that when they discovered their faults they began to make inquiries as to how they could improve the

situation, and they began to weed out their poor cows and reduce the number of animals. They have kept records; in fact, they are required to keep records; they are required to do their dairy work on a business basis. If they find an animal unprofitable, why, it is dangerous even to breed from her. Do you know, the great trouble in breeding lies in perpetuating the unprofitable animal? In Switzerland they take sires and try them out, to determine which one has the greatest prepotency and which one delivers the best calves. We as individuals can't do that, but as a co-operative affair in connection with these cow-testing associations we can do it. It is all very simple, if you have the records, to see which is the best sire. Another point; they don't sell these sires when they are seven years old. A sire is just at his finest when he is seven years old, and it takes about seven years to try him out. They use these old sires and they keep them just as long as they can. And we have got to do something like that, too; we have got to make a start in these cow-testing associations, and when a cow-testing association is started it is a very simple matter to regulate the breeding problem, because we have the records of the individuals. But in this country we feel like this: "I don't want anybody to know my business, and I don't want to know about the other man's business." In Ohio we started a couple of cow-testing associations and they went to pieces simply on account of jealousy. This spirit must be eliminated. Now as to this delivery proposition. We now have too expensive a system in delivering our products. I am glad that we have just broken the ice and have got the parcel post, but I am sure that within a few years we ought to widen the scope of this work; we ought to get together and fight out these problems. There are a lot of drawbacks that handicap us constantly which we ought to meet as they have been met in other countries.

Mr. John C. Orcutt. Mr. Chairman, I would like to ask the gentleman who just spoke this question. If he had a dairy of about 25 or 30 cows, and 15 or 16 head of young cattle that came from these cows, and he found out by keeping records for three or four months that there wasn't a cow

in that herd that paid him, what would he do with the herd? I believe there are in this State a good many herds like that. How are you going to dispose of such a herd so as to get a few dollars in return?

Professor Erf. I would try to sell it to anybody that didn't test; that is the first thing I would do. If I couldn't palm it off on him, I would have to sell the animals for beef. Isn't it better for you to sacrifice $30 or $40 by selling them for beef, and thus stop the leakage immediately, than to continue losing $40 or $50 every year?

Mr. Orcutt. Suppose you had $500, or any multiple of that, to start with. How would you advise going to work to start a paying herd?

Professor Erf. I would first start in with a small herd of pure-bred cattle. I would get myself one cow, if I couldn't get any more, and a pure-bred sire. Now, if I didn't have enough money to buy another animal I would buy some good grades.

I have started out with pure-bred cows and pure-bred bulls. The unfortunate part of this whole situation is, that in some localities there are no pure-bred bulls, so that a young man that starts out cannot afford to make use of them. You understand, if there was a community which had a pure-bred sire I would rather take my one cow there than go to the expense of keeping a bull.

Second Day.

Secretary Ellsworth. Ladies and Gentlemen: It is my pleasure to introduce Mr. George W. Trull of Tewksbury, who represents the Middlesex North Agricultural Society as a member of the Board of Agriculture, and who will preside this morning. Mr. Trull.

Mr. George W. Trull. Mr. Secretary, Ladies and Gentlemen: It is a great pleasure to me to be with you this morning, and I appreciate it. I have now the pleasure of introducing to you, as the speaker of the morning, Prof F. C. Sears, of the Massachusetts Agricultural College, Amherst, who will lecture on "Storage of Apples." Professor Sears.

THE STORAGE OF APPLES.

F. C. SEARS, PROFESSOR OF POMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASS.

To any one who will study the orchard industry of New England to-day, it is very evident that few branches of the business stand in greater need of improvement than our storage facilities. We have made and are making great advances in the growing of apples; there has been a marked improvement in the packing of our apples (largely through the influence of the New England fruit shows); and our marketing methods are developing every year; but in storage facilities and methods there has been little advance and less study. The writer is glad to see that the State Board of Agriculture is disposed to begin a campaign for better storage. We surely need it.

The chief advantages of good storage facilities, looking at the problem from the standpoint of the growers, are: —

First, that it makes the orchardist relatively independent when it comes to selling his crop. If the buyer knows that the grower has no satisfactory place to store his apples, he will naturally hold back in the hope that the need of a prompt sale will lower the owner's notion of what his apples are worth. On the other hand, if both buyer and seller realize that the apples are safe, that there is no need of haste in disposing of them, the price is far more likely to be a reasonably profitable one to the man who grew the fruit. In fact, good storage facilities put the transaction on the ideal plane, — perfect equality of buyer and seller. If they can agree on a price, well and good; if not, the apples can stay where they are. This comfortable feeling of independence is worth to the orchardist all that the storage will cost, and he gets his additional price as a clear profit.

Second, better storage will, of course, keep the fruit in better condition, and it will therefore sell for more when it *is* disposed of.

Third, the consumer will be better pleased with what he gets and will be more likely to want another barrel. Every business man realizes that there is no advertisement like a pleased customer, and the difference between a crisp, juicy, well-kept apple and one which is simply *sound* must be appreciated. In the one case you want to eat another apple at once; in the other, you don't care how long you go without another!

And fourth, good storage delays the marketing of the apples and so improves the price. Baldwins, for example, are almost certain to be higher in December than they are in October, and higher in February than they are in December. Nothing is more demoralizing to prices than to have good stock forced into competition with the windfalls and other poor stuff which is pushed onto the market in the autumn.

In considering this question of the proper storage for apples we ought to keep in mind the fact that the ordinary function of a storage plant is to hold in check the ordinary life processes in the apple. These processes are always accelerated when the fruit is picked from the tree, and they end (so far as we are interested in them) when the apple becomes unpalatable. The very low temperature of the refrigerated room allows these life processes to proceed, but at the very lowest rate, and as the temperature rises the rate increases.

The ideal storage ought to have the following points emphasized: —

First, relatively low temperature. So far as I am aware the exact temperature at which apples will freeze has not been determined, but it is probably somewhere below 28 degrees Fahrenheit. The ideal temperature for the storage of apples is probably from 30 to 32 degrees, but with good fruit very satisfactory results can be secured at 35 or 36 degrees.

Second, a constant temperature. Where the insulation of

the storage room is poor, the temperature, of course, rises and falls with the temperature of the outside air, and this is one of the chief objections to storing apples in ordinary cellars and rooms which are poorly insulated. The speaker once had experience with a storage room in which it was necessary to use an oil stove to keep the fruit from freezing during severe weather. As it was unsafe to keep this stove lighted at night, the temperature of the room would fall to nearly freezing by morning; then the stove would be started and the temperature would rise to nearly 60 degrees by night. The result was that the apples kept very poorly. The next year we put in furring strips along the walls and lined the room throughout with building paper, and the result was that with this improved insulation we could hold the temperature almost constant, even in severe weather, and our apples kept splendidly.

Third, the apple storage ought to have a relatively high degree of moisture. Just what this per cent is the speaker is not prepared to say. Mr. Madison Cooper, a recognized expert on such matters, gives 80 per cent as about right. What the speaker *does* know is, that in the Annapolis Valley, Nova Scotia, two growers who were especially successful in keeping their apples employed the following methods: one had a stream of water running through the storage room, and the other was in the habit of wetting down the storage-house floor (and even barrels in which Russets were stored) with the hose.

Fourth, the storage must be convenient for getting the fruit in and out. Few growers realize how much time is consumed in getting the apples into the storage, where they must be carried, one barrel at a time, down the cellar stairs. An elevator is usually the best method to use, though sometimes the barrels or boxes may be slid down an outside hatchway.

Fifth, the building must be reasonable in price. Just what constitutes a reasonable price of course varies. The cost will also vary with different localities, and the price that a grower can afford to pay and still make a profit will vary. But if an orchardist expects to store his apples in a

refrigerated building he can probably put up his own, if he is a large grower, cheaper than he can rent space in a commercial house. The usual price for the storage of a barrel of apples during the season is 40 to 50 cents. Assuming that a man is growing 1,000 barrels of apples he would pay $500 for storage, which is 5 per cent on $10,000. Now it is usually considered that a refrigerated plant can be put up for from $2.50 to $3.50 per barrel capacity, so that the man who is raising 1,000 barrels and putting them in cold storage is paying the interest on a plant that would store from 2,000 to 4,000 barrels.

Sixth and lastly, the plant must be operated cheaply. I propose to tell you what our college plant has cost. Others will vary of course, but to be profitable the plant *must* be reasonable in running expenses.

For our purpose this morning we may classify apple storage under three heads: —

1. What is ordinarily known as "frost-proof storage," where the temperature of the outside air is depended upon to bring the temperature of the room down to the desired point.

2. Refrigerated storage, in which the "cold" is produced by means of ammonia or some other gas.

3. Refrigerated storage, in which the "cold" is produced by ice.

The writer believes that all three of these systems are adapted to the fruit business, but especially the first and last; and as the college has recently installed a plant in which there is a combination of these two methods, it is proposed to spend a little time in discussing them.

The "frost-proof" section of our building includes three large rooms, with a combined capacity of some 2,000 barrels. The windows are equipped with heavy insulated shutters which may be easily closed when desired, and our method of handling the rooms is to start in the autumn and keep the windows open whenever the outside air is colder than that in the room. As soon as the outside temperature goes up the windows are promptly closed, and by careful attention to this plan the temperature may be forced down to a reason-

ably low point surprisingly early in the season. At the present time the temperature stands at 36 degrees in our large room, which is a good storage temperature, though of course not as good as 32 degrees; and it must be remembered that we have had relatively little cold weather this season during which the temperature in the room could be lowered. Last winter the temperature in this room on the 10th of January was 32 degrees, and it had only risen to 38 degrees on April 1. This is an extremely good record, and while it is *not* equal to a refrigerated room in which the temperature can be kept at 32 degrees without any variation at all, it certainly *does* keep apples well. For good, sound fruit of the late-keeping varieties, like the Baldwin and Spy, I believe that it has a distinct place of its own and a very useful place, and I believe, further, that any farm storage ought to include some rooms which are handled in this way, for it is, of course, much cheaper than refrigerated storage.

The balance of our rooms are refrigerated with what is known as the "gravity brine system," a patented method of refrigeration. For each room to be refrigerated there is located in the attic, or penthouse, a small vat or bunker lined with galvanized iron, in which is located a coil of pipes filled with a brine made by dissolving calcium chloride in water. This brine is made to test about 25 degrees on the Beaume scale, or about 4 pounds of the calcium chloride to 1 gallon of water. This makes a brine which will withstand a temperature of 10 degrees below zero without freezing. This coil of pipes in the vat (known technically as the "primary coil") is connected by two pipes (a "flow" and a "return") with a similar coil (known technically as the "secondary coil") in the room below, which is to be cooled. This secondary coil is hung from the ceiling of the room, either in a single section against one wall, in small rooms, or in several sections distributed through the room, in larger rooms. The flow of the brine in the pipes is controlled by suitable valves in the rooms to be refrigerated. When it is desired to cool one of the rooms, the connected bunker in the attic is filled with a mixture of broken ice and salt, using a coarse salt with particles the size of the end of one's little

finger. The ice is broken up in the ice room and hoisted to the attic in a large bucket holding some 400 or 500 pounds. This bucket, filled with ice, is then run along on a track (which extends the whole length of the penthouse) until it stands directly over the bunker to be filled, when it is tipped and the ice dumped into the bunker. Salt is then thrown in on top of this ice, another bucket of ice is put in, followed by more salt, and so on till the bunker is full. The amount of salt used varies with the temperature desired and with the outside temperature. It will ordinarily run about 5 to 8 quarts to each bucket of 400 pounds of ice. If at one icing 6 quarts of salt have been used and the temperature has not run quite low enough, more salt is used at the next icing. The temperature is also regulated by the valves located in the storage rooms which control the flow. If more "cold" is desired these valves are opened; if less, they are closed. With a little experience the system can be run very easily and very accurately. In our college plant the work is practically all done by the ordinary day laborer of the department. The foreman merely keeps track of the temperature from day to day, and gives directions as to the quantity of salt.

As to the working of the system, it is exactly the reverse of the ordinary hot-water heating system used in dwelling houses. In the latter the furnace is located in the cellar and heats the water, thereby rendering it lighter. This light-weight hot water then flows out through certain pipes and is replaced by the heavier cold water which comes down through other pipes from the rooms above, where it has been cooled off, or, in other words, where it has heated the air of the rooms. Now in this gravity-brine system the brine is cooled by the ice and salt in the bunkers and is thereby rendered heavier. It therefore flows down, and by its greater weight forces out the warmer brine in the secondary coils of the storage room, and is itself warmed up by absorbing the heat of the room and its contents. The frequency with which icing is required depends on the outside temperature, on the temperature desired in the rooms, and also on the frequency

with which new, and therefore warm, fruit is brought into the room. When the same fruit stands in the rooms for a long time it may not be necessary to ice more than once a week even in fairly warm weather. Where fruit is constantly being brought in and taken out again for shipment, it will usually be necessary to ice daily. On the other hand, it ought to be iced every day in warm weather (possibly twice a day in very warm weather) and every other day during autumn weather.

The great advantages of this system as thus far developed here at the college are the cheapness with which it can be run, requiring no high-priced engineers; the fact that any one of the rooms may be run without the others, thereby reducing the cost proportionately; the fact that there is no costly machinery to get out of order and cause large repair bills, and, most of all, the fact that it works satisfactorily, — that it "delivers the goods." Of course, it is especially adapted to those sections where natural ice may be secured.

The cost of ice will vary greatly according to the distance it has to be hauled, what the cost of labor is, and what, if anything, has to be paid for the ice. In filling our ice room at the college this year we put in approximately 250 tons, and the cost was as follows: —

Two men with double teams, eleven days, at $4.50 per day per team,	$99 00
Two men stowing ice, twelve days, at $1.75,	42 00
Ice,	28 00
Total,	$169 00

We have two refrigerated rooms of a capacity of 80 and 275 barrels, respectively, which we usually operate together. It takes two men from an hour and a half to two hours to ice these two tanks.

I want to close this paper with a short discussion of some of the factors which influence the keeping of apples in storage, for while a good storage house is very important, it must not be expected that it will take the place of care and proper methods in the growing and handling of the fruit.

1. I believe that by all means the most important single factor is the careful handling of the apples from the time they leave the tree until they are sent to the consumer. This would include, especially, care in picking, in packing and in handling the packages. In picking, the apples ought never to be tossed into the basket, and if they are poured into the box or barrel (which I believe ought not to be done with really choice fruit) the greatest care should be exercised to prevent bruising. In Hood River, Ore., I was told that they use galvanized pails for picking because the smooth, rigid surface does not bruise the apples, and because the picker who tosses the fruit into the pail can be located easily by the noise he makes. I believe that we might adopt the pail here to advantage. We certainly ought to banish the bag as a picking receptacle. In packing, the apples ought never to be handled roughly. The speaker recently saw one of our good orchardists packing apples in barrels. He had a packing table with a small opening at one end. A barrel was placed under this opening and the apples were allowed to drop from the table into the barrel. How many of them do you suppose escaped serious bruising? In one of our best orchard sections this autumn a large part of the fruit was bought by a dealer who used large slatted crates which held a barrel. The apples were hauled to the car in open barrels, the crates placed in position, and the apples poured into them like so many potatoes and the slatted cover nailed on. The speaker took the pains to examine one of these crates. On pressing one of the slats away from the fruit every apple which touched the corner of the slat was found to have a long bruise with the skin broken. These apples were going into storage and were eventually destined for the New York market. How well do you imagine they kept? And how much did they increase the demand for apples?

These are merely some isolated cases that have recently come to the speaker's notice. Hundreds more might be easily cited. This matter of careful handling has been dwelt upon because it is the all-important factor.

Some recent investigations by the United States Depart-

ment of Agriculture on oranges have shown that while fruit carefully picked and packed gave only 2 per cent of decay at the end of three weeks after arrival, that taken from the ordinary commercial picking and packing showed 16 per cent.

2. The second important factor is delay in getting the fruit into storage. This factor applies especially to fruit which is to go into refrigerated storage. As before suggested, the life processes are accelerated as soon as the fruit is picked *if* it remains at ordinary temperature. It ought, therefore, to be hustled into the coldest storage available. If "frost-proof" storage is used the temperature ought to be brought down as rapidly as possible in the autumn, so as to be ready for the apples as they are picked. Of course this damage from delay is more serious when the autumn is warm. Powell states that Rhode Island Greenings, Kings and Suttons, picked September 15 and stored within three days, kept in good condition till March, while the same varieties handled in the same way, but not put in storage for two weeks, were badly decayed by January 1. Their commercial value was injured from 40 to 70 per cent by the delay.

3. Fungous diseases stand third among the factors influencing the keeping of apples. The most serious of these are the molds and apple scab which develop very rapidly under favorable temperature conditions. Molds cannot gain entrance to sound fruit and scab can, of course, be controlled by spraying. But we all know that it frequently *isn't*, so that these fungous troubles become a serious menace when either the conditions of the fruit or the storage are not good.

4. Maturity of the fruit when picked. There is no question but that this exercises a very decided influence on the keeping of apples but just what degree of maturity is best has not yet been determined. There is a very general impression that the longer apples are to be kept the greener they ought to be when picked, but this is certainly a mistake. As nearly as one can give a general rule, it is probably safe to say that apples will keep longest if picked when they are fully matured and well colored, but while they are still

firm in flesh. It would seem that it ought to be possible to tell beforehand the approximate date at which the different varieties of apples should be picked by knowing the mean temperature of the growing season, and our department is working on this problem at the present time.

5. There is no question that soil and cultural conditions exert a very profound influence on the keeping of apples. A light soil will give fruit of poorer keeping qualities than a heavier soil, and apples from a cultivated orchard are apt not to keep so well as the smaller and firmer fleshed apples from sod orchards.

6. The type of package used will certainly exercise a decided influence on the keeping of the apples. The writer believes that the ideal storage package is a tight bushel box with a tight cover, or so arranged that one box covers the one below it. When barrels are used in comparison with boxes it will almost always be found that the greater mass of fruit in the barrel, generating, as it does, more heat and having greater weight, will *not* keep as well as the same fruit in a box, and for apples the ventilated package is certainly not as good as the closed one.

7. Lastly, a wrap will certainly help to prolong the life of the apple. The speaker has frequently kept Baldwins in ordinary storage in prime condition up to May by wrapping each apple in paper.

There are still many storage problems left to solve, — what type of storage shall it be; shall it be located in the orchard section or in the city; shall it be a large central plant or smaller ones on the farm? But this much is settled definitely in the speaker's mind, that some type of modern storage, at least part of it refrigerated, is a prime necessity if our orchard men are to get the most out of their crops.

Mr. Trull. I know we have all enjoyed the paper from the attention I have seen you give it. Professor Sears will be glad to answer any questions.

Mr. Abner Towne. Would it be practicable for a neighborhood or a community to unite and have a common storage plant?

Professor Sears. That is a point which I neglected to touch upon. It is the practicable solution of this question, where you have a neighborhood with a common interest. When in any section there are a number of men interested, we ought to get some type of storage plant started. It is only the large growers who can afford to establish such a plant individually.

Mr. Wilfrid Wheeler. I would like to inquire about a style of storage which I think is of importance. This is what you might call ordinary ice-house storage. There are several modifications of this, and the most common one that I have in mind is where the ice chamber is high up in the air and a good-sized room is located directly under it; there is another type where the storage room is built inside the ice house and ice packed all around it. I have several of these types in mind, and I think they make a fairly good sort of storage. I would like to ask Professor Sears what he thinks of that type of house.

Professor Sears. Mr. Chairman, I am glad that Mr. Wheeler raised that question. I had a little personal experience with one, the type where you have ice storage overhead. I think it is all right and will give pretty good storage facilities; but from my experience, which is rather limited, it is rather hard on the ice supply. We had one at the college and the ice usually gave out about the time we needed it the most. If a man had a better type of building and more ice he would get around that difficulty. I think it is a little wasteful of ice, but there is no question about its being efficient if you have a good building, and I presume that if one had his own ice pond, and the ice wasn't costing much it would be very satisfactory.

Mr. Wheeler. Would you break up the ice in the tank of your storage house or just put in the whole cake?

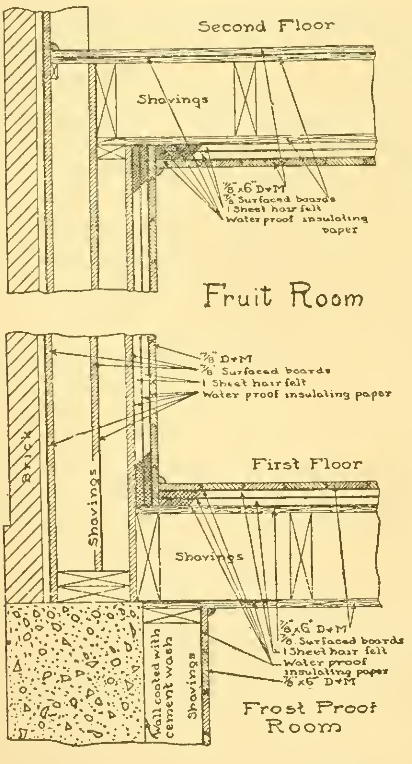
Professor Sears. Break it up; this has to be done in order to get the salt in through the ice and produce the proper amount of cold.

Mr. Wheeler. Is the temperature varied when the apples are in barrels and when they are loose? Will they freeze quicker loose than in barrels?

Professor Sears. They would freeze quicker loose simply because the cold air can get at them more quickly. I suppose that if you put in too much salt and get the room too cold the loose apples would freeze much more quickly than those in the barrels, simply owing to this fact, — the barrel is quite a protection because it doesn't allow the air to circulate quite so freely. I think in that connection all fruits, certainly all apples, should be stored in tight packages. I don't believe in the ventilated packages.

Mr. Munroe Morse. Do you separate bunkers for each room, or are they all supplied from one bunker?

Professor Sears. We have six of these bunkers and each has its coil of pipe, and that coil is connected with a separate room, one bunker and one pipe for each of the six rooms.



DETAIL OF INSULATION

The above diagram shows the type of construction of the walls of the refrigerated rooms. The walls of other parts of the building are much less complicated.

Mr. Frost. Should the storage room be below the ground?

Professor Sears. If you can get it below the ground the temperature will fluctuate much more slowly, and it is very desirable so far as insulation is concerned. The 10th of January last year broke all records outside, and the temperature in the underground room I refer to then stood at just 32; we kept it closed, and it rose gradually to 38 on the 1st of April. It took it all that time to rise from 32 to 38. If it had been above ground it would have risen much more rapidly, even with the best of insulation.

Dr. H. J. Wheeler. I would like to ask the speaker whether the use of a wrapping paper which was impervious might not be better than a wrapper which is very porous as it would prevent the evaporation of moisture?

Professor Sears. We have not taken up that matter. The wrapper is largely for holding moisture in the apple, and I should suppose that if something impervious, like an oiled wrapper, were used, it would be better than ordinary paper, as it would hold the moisture better.

Dr. H. J. Wheeler. I wish you could get your chemist to study the skins of apples exposed to the sun and those not exposed, in order to ascertain what the difference is. It is a most remarkable difference.

Mr. Frost. Doesn't the question of moisture have something to do with it?

Professor Sears. If you have plenty of moisture the open package would be all right if you kept the room moist enough. The conditions are controlled with the closed package, however, a good deal better than they can be controlled over the entire room.

Mr. C. P. Greenwood. Will a perfectly sound apple be injured by contact with rotten apples?

Professor Sears. I think it would depend on what was causing the rot. If it were merely a breaking down, a physical change, going on in the rotten apple, I shouldn't think it would hurt. It would hurt the taste, of course. But if it were being destroyed by mold then the germs of that mold would be very likely to get on the other.

Mr. Greenwood. I heard a fruit grower say some time ago that he didn't believe a perfectly sound apple was injured by a rotten one touching it.

Professor Sears. Perhaps not if you have a perfectly sound apple without a break or weak place on the surface, as mold or disease probably wouldn't get in. The flavor would probably be tainted, as it is in the case of a partly decayed apple.

Mr. F. A. Russell. I would like to ask if in the construction of a cold-storage plant it would be economical or advisa-

ble to construct a building large enough to hold other things, vegetables, say, in conjunction with the fruit, so that you could store everything that you raised, beets and onions and parsnips and cabbages, in the same building?

Professor SEARS. That would depend altogether on the circumstances. If a neighborhood were growing all these different things and were keeping them there I think it would be very desirable to have them provided for in the building. We have both in our storage building, but there is only one door between the two compartments and that is kept locked. Care must be taken that the odors don't get from the vegetables into the fruit compartment. This is a danger which can be easily avoided, and I think it is a very satisfactory arrangement, because you can put up your vegetable storage a good deal cheaper if you combine the two than by making it a separate storage.

Mr. JOHN P. BOWDITCH. How much would the investment be to build such a cold-storage plant as the one you have described?

Professor SEARS. The figures I mentioned run all the way from \$1.50 to \$5 per barrel capacity of the storage; and the general opinion seems to be that about \$2.50 is the average cost per barrel. Perhaps if you strike an average of about \$3 per barrel you will have it, so that if you want to put up a 1,000-barrel plant it will cost you, complete, about \$3,000.

Mr. R. H. RACE. I had an old ice chute on my farm. It was 16 feet long and 20 inches wide inside, of 1½-inch oak slats, 3 inches wide, bolted together, and the slats across for protection with the bolts set in so that they wouldn't interfere with the ice. The idea came to me that this could be used in putting barrels of apples into the cellar. I cut a square piece out of an old bran sack, slipped it over the barrel and drew it up with an old strap below the two top hoops, so they wouldn't break open when they were sliding down. I then got a couple of pairs of ice tongs and gave one to each man and they carried the apples in there just as fast as they could slide them down. It was a very simple arrangement and I put in 200 barrels of apples in short order, and there was no

inconvenience, discomfort or damage to either the apples or to the men, and when we took them out I used the same device; took a pair of ice tongs and put a rope through one handle and attached it to the other and slipped it over the head of the barrel and hitched a horse on, just the right length rope, and out came the barrel without bruising anybody's fingers. This is a very simple device which I just stumbled onto and thought I would give it to you.

Mr. G. D. Forrestall. Apples will stand a much lower temperature if wrapped in paper than they will without it and will keep better. I speak of this for home use, as we cannot all have cold storage.

Mr. Wilfrid Wheeler. I think the question in regard to combining storage that will take in fruits and vegetables is worthy of further discussion. I have often seen the time when asparagus, held back for three or four days, would bring double what it does when there is a glut in the market, and I believe we should have a central storage plant wherever there is a large enough crop in any section to warrant it. I think these central storage plants should be constructed and perhaps run by the farmers themselves. I believe it is perfectly feasible to use the same one for both fruits and vegetables, and I think that farmers should co-operatively build just such storage plants.

Mr. J. J. Erwin. Would such a cold-storage plant be suitable for keeping milk?

Professor Sears. We haven't used it for milk. I don't see any reason why it shouldn't, though. It is all right for anything that wants cold. I don't see why there should be the slightest objection to storing asparagus in the small room, as there is no offensive odor.

Secretary Ellsworth. I think that the farm which is doing a considerable business in a variety of crops can well afford to have a cold-storage plant. There are times in the summer when there seems to be a glut of certain varieties of vegetables, like tomatoes, cucumbers or asparagus, when if they could be held for a few days the farmer could get a great increase in the price. And as for apples, Gravensteins

that were selling perhaps this year for 75 cents and $1 a bushel, a little later were selling for one-third more, and I don't know but for double that amount. I know that the added profit would easily pay the interest on the investment.

Mr. G. F. Morse. Would it not be valuable for Bartlett pears? They are a quick-ripening, quick-softening pear, and I should think it would be just as valuable for them as it would for apples. I believe that it could be profitably used for both pears and peaches. In the early part of September, when the Elbertas come along, if a man could hold back a week he would undoubtedly double the price; this could also be done with pears, and especially with Bartletts. It doesn't make any difference what a man is selling, if he can hold back for a few days, say a week to two weeks, he will often double the price received and sometimes even more. Cold storage helps out the other fellow who has not such facilities, also, in preventing a glut on the market. If every grower were equipped with a plant, prices would be better and the fruit season would last longer for the consumer.

Afternoon Session.

Secretary Ellsworth. I wish to introduce the gentleman who represents the Amherst Agricultural Society upon the State Board of Agriculture. Mr. Howard A. Parsons.

Mr. Parsons. Ladies and Gentlemen: We have here in Massachusetts an agricultural college which we feel sometimes is the fountain of all knowledge, and our college grows better every day, but still we don't claim to have all the knowledge; and this afternoon we have with us Prof. James C. Rice, Cornell University, Ithaca, N. Y., who will give us a stereopticon lecture on "Some Practical Points in the Management of Poultry for Egg Production."

SOME PRACTICAL POINTS IN THE MANAGEMENT OF POULTRY FOR EGG PRODUCTION.

PROF. JAMES E. RICE OF CORNELL UNIVERSITY, ITHACA, N. Y.

What I shall say this afternoon will bear directly upon the farmers' poultry problems, because the great bulk of the poultry products always have been and probably always will be produced on the farms and not on little bare yards of congested poultry plants. Poultry husbandry is an animal industry. It is a part of a general farming system. Any one who undertakes to establish an individual poultry-producing enterprise, strictly for poultry and on a very limited amount of land, as people have been accustomed to think they could do, will see that he is handicapped beyond all measure as compared to the man who keeps poultry on a farm, and for the very same reason that he would keep cows or sheep or hogs, because it is live stock, and because poultry should be kept as a part of a well-balanced system of rotation of other stock and other crops on a farm. He is the man who in the end will get the most money and the most satisfaction, with the least risk and with the least amount of labor. That is good, sensible, business poultry farming. We must adopt in this country a system of poultry farming that will enable us to keep 500 or 1,000 hens on farms where farmers have been accustomed to keep only 50 to 100. We can do this and still let hens have the benefit of the fields and orchards where crops are growing, so that instead of charging up a given amount of land to the hens, the hens will be credited for having occupied the land, because the good that they do to the farm crops, to the orchard, to the asparagus bed, etc., is so much clear gain from the productive standpoint. Therefore, instead of being a damage for which we must charge the hens for the land, they are

simply using it incidentally in connection with the other crops. If we give them land enough to roam over they do not seriously interfere with the crops, but, on the other hand, help the crops which occupy the land at the same time.

Poultry should be kept for three distinct purposes: First, for the meat or the eggs that they produce; and they will justify the cost of the food and the cost of the labor and the care that is given them on that basis alone. In other words, the margin of profit to-day in the production of eggs or poultry meat will justify feeding the foods that we must produce or buy at the present high prices. Second, poultry husbandry is justified on the farm because of its soil-enriching value. You can credit your hens with about one-fifth of the value of the food that you have given them, in the value of the fertility they leave on the land. When it costs you $1 a year to feed a hen, about 20 cents of that amount stays on the land if the manure is properly handled. In the State of New York we estimate that in the towns and villages and on the farms there are in the neighborhood of 20,000,000 hens. You can see that one-fifth of the value of $20,000,000 worth of feed is $4,000,000, the value of the manure, since it costs us about $1 to $1.20 a year per hen for feed. That is of great importance to the State of New York as regards keeping up the fertility of the farms and making the land more productive. Third, hens are valuable on the farm because of their value as scavengers. Hens are justifiable in large numbers on most farms because of their value as insect hunters and as gatherers of the grain and other things that are liable to be wasted because no other class of animal on the farm will be able to utilize it.

From these three standpoints alone hens justify their existence on the Massachusetts and New York State farms. As direct confirmation of these three points there are records of thousands of farmers who are keeping hens successfully in Massachusetts, in New York and in other States. We have kept careful records of hundreds of hens at the college for the past eight years, showing the cost of the feed and the number and value of eggs produced. We know that there is a large margin of profit when the hens are properly

handled. There is a man in your audience here to-day, one of your own number, whom I have known for several years, who is making good, clear profit on the sale of eggs and roasters. I can refer you to farms in New York State — and if I were sufficiently familiar with your State and its farms I know I could say the same of them — where hens have been kept in an orchard where large crops of apples or other fruit are grown that could not be grown a few years ago. I have seen orchards nearly broken down with their loads of fruit where hens have run for a few years, whereas orchards without live stock, right on the same farm in adjacent fields, are still unthrifty and unproductive. I have seen "volunteer" fields of clover follow naturally without seeding where hens have pastured. On the Cornell farm this year there are spots where clover is running in like a mat where brooder houses stood the year before. The securing of good crops is frequently a question of an adequate supply of plant food; it is a question of saving this material to enable the soil to dô its best work. Hens justify themselves on the land improvement basis alone. As insect hunters, poultry of various kinds are valuable. In our State, on Long Island and some other sections where asparagus, for example, is grown extensively, the asparagus farmers have fences around the asparagus fields, and let hundreds of chickens run in the fields to catch the pernicious beetles that spraying will not kill.

We have two principal problems to face in our endeavor to make poultry husbandry pay. The first one is to produce an efficient machine, because the hen is a living machine and is just as truly a manufacturing plant as any manufacturing industry in the State of Massachusetts, and sooner or later the business people of the cities and towns must come to recognize that a person who owns a hen factory out in the suburbs or within the city limits is just as much entitled to consideration as any other manufacturer would be who develops an infant industry. This would be on the ground that it brings in money and labor and is a business investment that you can well afford to encourage. Cities and towns will aid manufacturers by giving them various important consid-

erations — building sites, relief from taxes, etc., — in order to induce them to locate in their town to manufacture shoes or clothes or clocks, while in those same neighborhoods there are many farmers, poultrymen and dairymen who are manufacturing from the raw materials the most highly finished products known to man, — milk, eggs, poultry, etc. Hence it is that our hen is a vital, living machine, and if we are going to make money out of her she must be built especially for her business, as the best of complicated machinery, like the printing press or the locomotive, is built for its business.

Hens have several kinds of business on hand. Some of them are just for show; for exhibition only; they are the aristocrats. Some are built for meat production; they mature early, develop strong bodies, with quick growth and well-distributed flesh with a small amount of waste material; they are the broiler and the roasting fowl. Other hens are built on an entirely different plan. Their mission in the world is to produce just as many eggs of the right shape, size and color as we can get them to produce and still keep strong and healthy; and these are the egg-laying machines. Then we have groups of hens that are pretty fairly good all-round individuals. They are really the genuine Yankee hens. They combine in one type many of the essential qualities.

The point that I want to emphasize now is that if we are to make money from high-priced food such as we have to feed we must so select and so breed that the hen, our machine, will give the largest possible measure of return.

The second point is to get the right kind of food, — the right kind of a ration, so that when we feed the highly organized animal she is going to give us the largest measure of efficiency of which she is capable. There are many good, industrious, hard-working, well-born hens in this and every other State which never have had an opportunity to do what they want to do and can do in the matter of laying eggs. Hens like to lay and chickens like to grow; it is simply a question of giving them the right kind of food and environmental condition that will let them follow along the line of least resistance and do what gives them the most fun. They are like normal, well-organized persons. They will be

likely to succeed best if allowed to do the thing that they like to do best. So let us try to find out how to house the hens, how to hatch the chickens, how to brood them, how to feed them, how to select and breed them. We have two main factors, — the high-priced raw material and the splendid, well-developed machine. It is for us to bring them together and get results.

There is another phase of the question which is of equal importance with these two, and that is the question of marketing the product, the question of getting all that belongs to the man who goes to the expense and trouble of production. And right there is where you people in Massachusetts are blessed. Sometimes it takes a person a long time to find out when he is well off. Sometimes he will grow up in his community and not realize his blessings. We may have to take a long trip to other States and then come back to see and realize what a good place we are living in. You people are blessed beyond all measure in your markets: I don't know any other country where you can get a higher-priced local market for poultry and poultry products of the right kind and quality than you can right here in Massachusetts. You are making the mistake of your lives if you don't buy the grain, if necessary, and feed it to your hens, to make the eggs and chickens that sell at high prices, instead of letting the people in the west and the middle west supply your markets with poultry products. Carloads and train loads of poultry and poultry products are coming into this State and New York State every year. We are not producing enough to feed our own people, and so long as that condition exists it seems to me that it is "up to us" as farmers to see that our people are well fed when they are willing to pay the prices that they do for our products. When it comes to marketing the product it means the supplying of the kind of product that the people want. For my part, I am not going to argue for one minute with customers who are willing to pay 5 cents a dozen more in order to get brown eggs or to get white ones. They can have what they want if they will pay the price. There are people, in Boston and elsewhere in the United States, who have a notion

that brown eggs are richer than white eggs, and that they are fresher and better. As a matter of fact, hens usually lay "fresh eggs," whether they are brown or white. But the people of Boston know that brown eggs generally are fresher than white eggs. It is because most all the eggs that are produced in that neighborhood are of that "complexion," and the eggs that are of another color are more liable to be produced way out west, and perhaps have been in cold storage for a long time. On the other hand, people in New York City have a notion that white eggs are a good deal better, both inside and out, than the brown eggs, and therefore they will pay from 5 to 10 cents — and I have seen them paying 15 cents — a dozen more for white eggs of the same size and freshness and similar shape. That is drawing the "color line" pretty sharply, but they are willing to pay for it. Well, let them, even though one egg is not worth one whit more than the other, by chemical analysis or otherwise.

The point I want to make clear is this: that we must first find out what our customer wants, make it as good as we know how and then demand the price for it. We are liable to get it. Life is too short for us to try to educate public opinion on that score.

How are we going to get the most efficient machine? Breed it. Start with good, pure-bred stock or eggs, and then select. Why start with a pure breed? Very largely for the reason that pure breeding represents uniformity of some character or quality that it has taken many breeders fifty or seventy-five years to accomplish. It has taken over fifty years to produce the magnificent breed known as the Barred Rock, and half as long, perhaps, to produce the White Rock and some of the other well-known substantial varieties. Somebody has spent all these years in emphasizing a certain quality until they have fixed it, so that when the eggs hatch from one of those varieties you can reasonably expect the chickens to look like their parents. That is worth much from the standpoint of uniformity of production, size, shape, growing quality and living ability, — all of those qualities which we desire to develop represented in a type that will

breed reasonably true. Then, instead of having a lot of chickens of all kinds and sizes, big and little, broad and narrow, lean and plump, yellow skin and pale skin, smooth shanks and feathers, rose comb and single comb and topknot and all sorts of combinations mixed up, ringed, streaked, spotted and striped, for market you have a poultry product that is uniform. With all those mixed colors, types and sizes precisely the same marketing situation develops that would exist if you should send out your apples mixed up, — sour and sweet, yellow and red, spotted and striped, big and little, long-stemmed and short-stemmed, and all the other combinations mixed up in one barrel. They would be called cider apples. What are you going to call eggs that show three or four different qualities in one basket? I know what people think; the minute they look at those eggs their first impression is unfavorable. They think that "eggs is eggs." Whenever you cast doubt upon the character of an egg it is all off with the egg. They simply say that these eggs are from no place in particular but from everywhere in general; that because they are of so many different kinds they must have come from this man and from that man, and have been gathered from everywhere in the neighborhood. But if they are all brown or all white or all cream colored, or whatever the tint may be, but uniform, they look good, and people want them and they will pay the price for them. That is one of the things you get from pure breeding.

And yet, friends, lest I be misunderstood, I want to say right now that we might better have the veriest flock of mongrels of all kinds and descriptions that have good health and ability to eat, than to have the finest strain of pure-breeds in existence if they lack stamina, as many varieties do. It is worth while to take the best of the pure-breeds we now have and make them conform to our standards of vigor, health and productiveness. Then we have the ideal condition.

How are we going to get hens that lay more eggs, especially when eggs are high priced? Affairs sometimes work out for our good when we least expect it. We can count as a great advantage the fact that when we find hens that will

lay the most eggs in the year, they also lay a large percentage of those eggs when they are high-priced. When we find a hen that lays only a few eggs in a year she "adds insult to injury" by laying them when they are cheapest. Therefore, the man who gets the largest production per hen also gets the largest average price for his eggs because the best hens, to use a baseball term, "bunch their hits" at strategic times. They produce eggs when we want them the most. They don't lay any less in the springtime than do the poor hens. It is simply a question of a hen being born right, with a tendency to lay, and then having her properly fed and handled.

I am going to ask a couple of our friends here in the "bald-headed row" to hold up, so you can see it, a chart, in order that you may understand what I cannot show you on the lantern slide (Fig. 1 a, b, c).

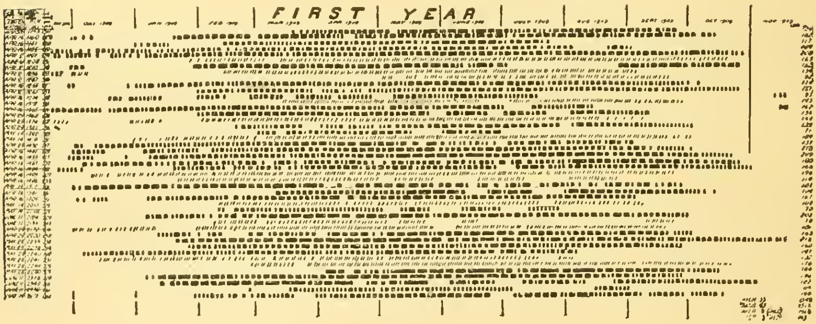


FIG. 1 A.

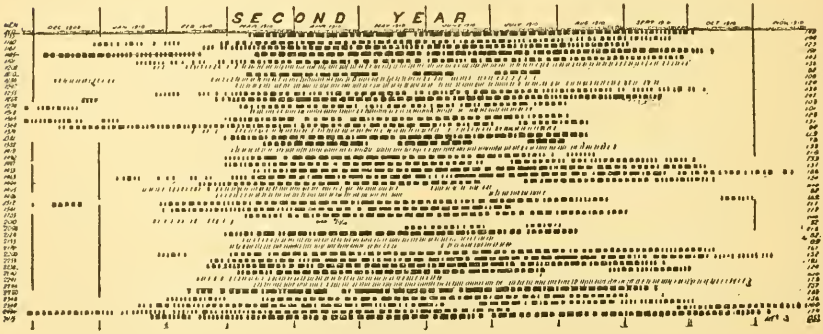


FIG. 1 B.

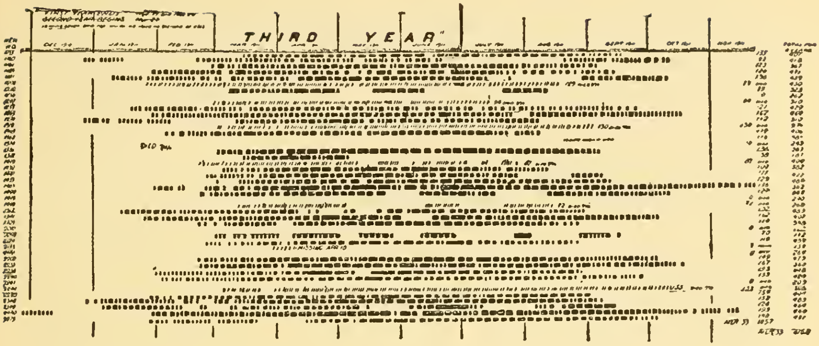


FIG. 1 C.

This will show you the result of the daily egg production of a certain flock of trap-nested hens for three years. Mark you, it isn't a different flock for each year, but the same hens day after day, three hundred and sixty-five days in the year for three years. We will see when the good hens are laying and the poor ones are not laying. Let me explain the key to you.

Each one of the lines on the chart represents the daily production. Each square is the egg production of each hen per day, and these are the months, December, January, February, etc., — remember, beginning with December and continuing right through until the end of the year, then beginning on the second year the same way and in the same manner for the third year. So each one of these lines represents the daily production for the first year, for the second year and the third year. Wherever a hen had made her best record in her first year we have given her a blue mark; that is first prize. Wherever she has made her medium production we have given her a red color, so that some hens, you will see, made their best record in that first year and are blue; the next record will be red and the next brown. Or you can reverse it. We have got one hen here that surprised us all. We named her "Cornell Surprise," just because she reversed the expected order of things. What do you suppose that foolish hen did? She laid 180 eggs the first year. A hen is ordinarily expected to lay about 10

to 12 dozen; 11 dozen we feel is a good average year, 150 is called very good production and 175, rare. This hen laid 180 the first year and got started and couldn't stop, and laid 186 the second year and 196 the third year. That is most contrary to the usual expectations. We find that 33 hens here laid on an average for three years 153 eggs apiece the first year, 136 apiece the second year and 127 apiece for the third year. You see the order of the gradual slight decline from the first year to the third year. We made the same kind of a study with another flock of 38 hens and the same with a flock of 88, and we find that the same general principal holds true, — that hens usually lay best the first year, less the second and still less the third. This decline is about 1 to 3 dozen eggs per year. We find, however, that in many, many instances the third-year production of some hens was equal to or better than the second year, and we frequently find that where hens have struck the blue mark in the first year of high production they may strike the brown mark of low production in the second and, after resting a while, come up in the third. We find that generally with the Leghorns, where they have made a high production the first year, they are quite likely to make as high or higher production in the third year than they do in the second.

There is one point I am trying to lead up to, which I want to emphasize to-day as vigorously as I may be able, and that is that we as poultrymen have been committing the crime of ignorance in the breeding of our fowl in the past, largely because we did not know the individual production of the birds. The mistake is this. It has been the custom of some of us to breed from immature males and females instead of the matured birds, and in so doing we have made two mistakes: first, breeding from immature stock has had a tendency to reduce the size of the bird; and second, a tendency to reduce the normal length of life of the race. Many hens will produce well in their first year and die in their second or third. If we had bred from those fowls that in their first year gave good production and

later died, we would have been perpetuating a type of short-lived fowls, whereas if we had bred from hens that we selected for high production by means that I will explain in a few moments, that have lived two years or three years and are still strong, then we would be more likely to have hens that are not only productive but that also have proved their ability to live long. Such hens exist and are the very best fowls for breeders.

I am going to pass around in the audience some printed sheets, upon which are given the rations that we are feeding, and on the bottom of the sheets you will see the records of the four best hens that we have been able to breed in Cornell in the eight years we have been keeping trap-nest records. These are three-year records. I want to read you the three records for each of those years, in order that you may see that the fact I have stated is literally true, — that it is possible to get a hen that is born strong, with a tendency to live long, with a high productive tendency in her veins and one that can stand up under high production.

We took photographs of the three hens we now have living the latter part of November. None of them had molted. Every one is the picture of perfect health (Fig. 2).

Creation has only begun. The good Lord gave us the animal to begin with, but he left it with his people, by their intelligence, to bring out these qualities and improve upon them, and it is for us to take these highly organized individuals and make them better. Here is the evidence of man's power. From the little wild "Gallus Bankiva" hen, way back in the jungles of India, laying 9 eggs at a litter and not to exceed two litters a year, has been developed nearly all of our races of domestic fowls, more than 100 varieties breeding true, and including hens producing 665 eggs in three years, more than 220 eggs per year.

Let us now take up one or two ways of selecting fowls with regard to finding out which are our highest producers. Trap-nesting is not feasible for farmers generally; it costs more than 50 cents a year per hen to work the leg-banding, recording and keeping the records and pedigreeing chickens,

etc. A few poultrymen and the experiment stations can and are expected to trap-nest.

Are there any ways by which we, as practical farmers who haven't time to trap-nest, can get a reasonably accurate method of picking out our highest producing birds? There are a few indications that will help us, and one of them — understanding that it is not an infallible rule, but you can see from the figures how it works out — is to pick out your birds and group them according to their age. Most poultrymen hatch their chickens within a short period, one big lot hatching in April, another early in May and another in the latter part of May, so that they have a large number in each flock about the same age. If you can keep these birds by themselves as pullets when they are laying for the first winter, and notice which ones lay in the fall and early winter, by finding them on the nest and marking them, you have made one big step towards picking out your future winners in egg production. For example, taking the same 33 hens that we were discussing a few minutes ago, and grouping them according to the age at which they began to lay, — all having been hatched at about the same time, — grouping them in this order we will have in Group 1, 17 that began to lay when two hundred and forty days old or less, averaging two hundred and twenty-one days for that group. These hens laid 176 eggs in their first year, 143 in their second year and 132 in their third year, giving us an average of 451 eggs in three years. Taking the hens that were hatched a little later, in Group 2, there were 9 hens that began to lay from two hundred and forty-two up to two hundred and seventy-two days old, averaging two hundred and fifty-one days old for 28 per cent of them. They averaged 138 eggs the first, 139 the second and 134 the third year, or 411, averaging 40 eggs apiece less than the hens that began to lay thirty days earlier. Do you catch that point? All were of the same variety, — Leghorns, — all were bred together, all fed together, and all the same lot of eggs hatched together, and yet those that began to lay first laid 451 eggs in three years, while those that began to

lay thirty days later averaged 411 eggs, 40 eggs less in three years' time. Of the other group, the hens that began to lay from 270 to 353 days old, or 18 per cent averaging 307 days old, averaged in three years 328 eggs. I am just going to repeat those three-year totals. Those early to lay, 451; those that began to lay of the medium age, 411; and those that didn't begin to lay until the following spring averaged 328, the difference between 451 and 328 making a difference of 123 eggs.

The point is this: if we are going to breed for egg production, can we afford to let the pullets all run together, never knowing whether they lay in the fall or spring, and just breed from what we have on hand? Why not catch those pullets that you see laying in November, December and January and mark them, punching a hole in the web of the foot or tying a rag around the foot; do anything, only mark those pullets so that later when they become two years old you can select from them for breeders.

Another point in selecting the breeders: in the second or third year, when you get ready to breed from them, watch out and see which pullets or hens molt last. You will see on the lantern slides a pretty good story illustrative of late molting and high production (Fig. 3). That is the most certain indication of high producing that we have ever found. A hen that is a high producer almost invariably molts late in the fall or early winter. The three highest producing birds we have ever been able to raise haven't molted yet (November)! The hens that lay but few eggs usually molt early and get on their new suits in the fall, and strut around in their new styles and put on all the airs that lazy aristocratic hens are entitled to do. And what have we been doing in the past? All of us are guilty of it. We have killed the hens that molted late just because they committed the crime of laying too many eggs, and we have let the hens live that molted early because they hadn't anything else to do, and just because we thought that if they molted early they would get on their new plumage and be ready for cold weather and lay best. We find, however, that the best producing hens molt late, in November and December, and take

less time for molting than do the others. They get through earlier, and begin to lay quicker after they get through than do the others. They are born to lay and they therefore follow the line of least resistance. It is perfectly natural for them to do this.

The hen must be naturally strong that can lay well for one year, two years and three years. Then, we want to get the most vigorous and the most prolific and those that live the longest, and if they live long they will be more likely to produce chickens that will be reasonably certain of long life; hence we want to pick the birds that have proved themselves for three years and then breed from them, and that is what we are doing.

We haven't broken through the crust of knowledge of the subject of poultry husbandry, and yet we have been keeping hens for centuries, ever since the time of Noah. The biggest crime that most of us have committed is the crime of ignorance in handling the forces of nature. I say that in all humility.

The first few slides will deal with the question of the importance of breeding fowls for constitutional vigor, supplementing what I have already said on the subject. Here are four individuals of two different varieties (Figs. 4 and 5), and in each one of these groups is a strong one and a weak one, born so or acquiring that weakness. Can you tell which one you would want to use to breed from? I doubt if there is any one here who hasn't the discrimination to see the distinction in body type between the two Barred Rocks (Fig. 4), — the weak-vitality individual and the strong one. You can see by the shape of the body that this fellow on the right lacks capacity to carry and digest food. Do you see how narrow he is between the hocks? They are so close together that he would need interfering straps, while this one, if he could be seen face to, you would find was very broad between the hocks. The body is so broad and wide and full that it spreads the legs apart. You haven't got the slab-sided individual here on the left that you have there on the right. You notice the same characteristics between the Leghorns (Fig. 5). You will notice that this bird

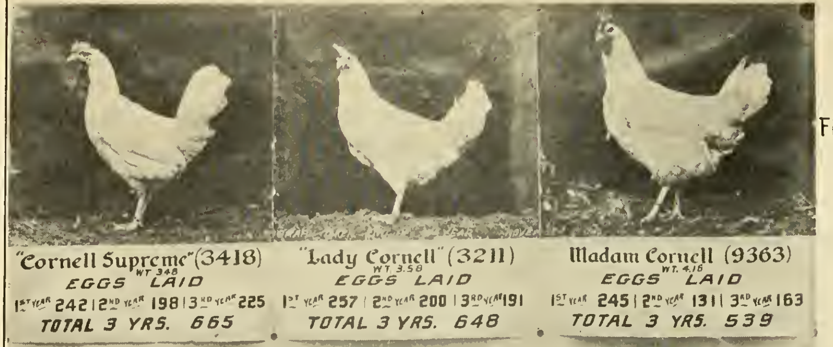
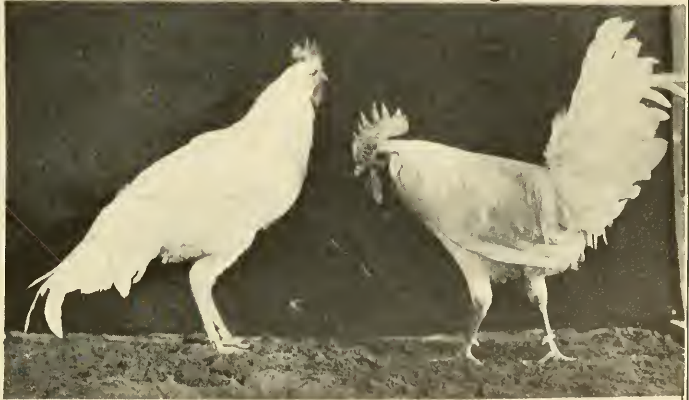


Fig. 2.

Fig. 3.

Vigorous Fig. 4. Low vitality

Low vitality Fig. 5. Vigorous



on the right is blockier and deeper, a better parallelogram type. The low-vitality birds have a tendency to fill a triangle, while those of high vitality have a tendency to fill a parallelogram, well filled out at the breast and the abdomen; in other words, in the latter you have the greater vigor, greater eating capacity, better growing capacity, a better individual all around. These birds are the same age, and this one would weigh from 1½ to 2 pounds more than the one of low vitality. The Leghorn on the left has a longer shank than the other one and a longer neck, but lacks depth and capacity.

Now, notice the way the white Leghorns stand. One is a timid, frightened individual and the other is a bold, vigorous, courageous individual. That fellow is looking for a scrap, and this fellow expects it and tries to get away. Notice the difference in the size of the comb, size and shape of the facial appendages, the way they carry their tail feathers and the way they crow, because the birds that are good breeders, the birds you would want to get to mate, whether male or female, are the ones that cackle and crow loud and long. Never but once in demonstrating high and low vitality have I known a low-vitality male to crow before an audience, and that was when there were two birds in one coop, and the coop fell down and the two got together and had more or less of a scrap, in which the vigorous one was on top most of the time. We picked up the birds, and the low-vitality fellow illustrated a human characteristic in hen nature, — he was so glad to get away from the other fellow that he crowed. You have often seen those who did not dare to fight on one side of the fence, wait until they got over to where the other fellow could not reach them and then "sass back." That is exactly what happened here. But crowing is a splendid sign of vigor and masculinity, the same as cackling and singing are fine signs of femininity. Time will not permit me to go into all the details, to distinguish low from high vitality. Size alone doesn't indicate it.

Here we have a capon (Fig. 6), a nonsexed individual on the left as compared with the Barred Rock cockerel of the

same age on the right. The latter is one of the finest specimens of sex vigor we have ever bred, a magnificent bird weighing less, however, than the capon, — the one, husky, vigorous and active, the other, sluggish and slow. The capon doesn't make the best use of his food. He grows bigger and softer and sells for more money per pound, but so far as using up a pound of food economically is concerned, he doesn't digest it as thoroughly as does the sexed male. Notice this one of high vitality, with its heavy, thick comb and the heavy, curved beak and the round, full eye, compared with the long, flat, peaked beak and the shriveled comb and sunken eye of the capon, indicative of less vigor. The capon, however, probably would weigh 2 or 3 pounds more than the cockerel of the same breed.

This slide (Fig. 7) illustrates the explosion of a fallacy. You will notice a good deal in the poultry press in regard to chickens' wings growing so fast that it stops the vitality, and the people have resorted to cutting off the feathers of the wing so that they would not exhaust the chickens' strength. You might just as well cut off a cow's horn or the end of her tail to affect her strength. These chickens (*a*) and (*b*) are of the same age and the same variety, fed in the same brooder; these (*b*) were born strong, vigorous and husky; and these (*a*) were born weak or acquired weakness. Now, if you could see that chicken (*a*) alone, its wings would look vastly out of proportion to its body, while this one here (*b*) is properly proportioned as to body and wing. These (*b*) are growing normally and naturally, whereas on this one (*a*) the wings are out of proportion, and what you are seeing is by contrast. What happened over here (*a*) is that the wings did not grow too fast, but the body did not grow fast enough. You can pick out the high and low vitality in chickens from the day they are hatched by the way they eat, and by the eye and the comb and by the head points, as indicative of those characteristics. The way a chicken feathers is one of the best evidences of its vigor.

Here (Fig. 8) is a flock of White Leghorn hens picked for high vitality. You can see the full, well-developed,

parallelogram-shaped body, fine head, good, big comb, fine, bright, round eye, and good, heavy shanks, set wide apart. In the next slide (Fig. 9) you will see their sisters, hatched in the same incubator, brooded in the same brooder and fed alike. They are simply separated because of difference in vitality. Do you notice the difference in type? Those low-vitality birds (Fig. 9) are a little hollow-breasted, and if you could see them faced the other way they would be narrower between the shanks; they would also be more slender in the shanks, more delicate in make-up, not quite so large, or with a comb not so large or perhaps of so high a color.

On this slide (Fig. 10) you will see their chickens. The eggs were selected from those two groups of hens just shown, incubated in the same incubator, brooded in the same brooder, ran together all summer long in the same corn field, only distinguishable by the number on their leg bands, and in the fall they were brought up together and separated and photographed. These above are the pullets hatched from the high-vitality hens and these below are from those of low vitality. Those above weighed half a pound apiece more than those of low vitality; they also began to lay several weeks earlier, and they laid more than a dozen eggs apiece per year more than those of low vitality, and they paid us a profit of between 40 and 50 cents apiece more per hen. There was a difference of 1 pound apiece in the same experiment, where Plymouth Rocks were used instead of Leghorns, the Plymouth Rock being a bigger bird. Just think of the distinction in quality you get when it comes to selecting birds!

We don't have to begin with the chicken. We can begin with the egg. We can tell a chicken of high vitality before it is hatched. We simply examined the eggs in one incubator at the end of seven days, and divided them according to the way the heart throbbed and the size of the blood-vessels. We picked out one group from the other, and at the end of the hatch we fixed it so that the chickens had to fall into separate trays so that they could not get mixed up, and this picture (Fig. 11) shows the result. These eggs were left from those selected from high-vitality chickens and these

were those left unhatched from those selected for low vitality. There were 77 per cent of these hatched from the high vitality and only 33 per cent from the low vitality, and all of these are weak as compared with all of those, which are strong. So you see that way back in the egg you can tell the difference between high and low vitality.

Next in importance after selecting for constitutional vigor, whatever the breed may be, is the selecting of a breed that will best meet your requirements. This slide (Fig. 12) is simply a contrast made by some of the people in our department who have been studying, for five or six years, six individuals, three males and three females, of as many different breeds as time has permitted. This is just the contrast between the White Leghorn and the Barred Rock. We also have figures upon the Rhode Island Reds and the Indian Game and others; but I picked out these. They were first photographed alive, then "dressed" and photographed; they were then cut up and put on a board that is marked off in half-inch spaces in multiples of 100, and their organs and parts were cut up and laid down in the same form, so that they are directly comparable. They were then weighed and measured, and then the muscles were taken, sections from the breast and thigh, and here you see represented on this group at the right a cross section of the muscles of the White Leghorn as compared with the muscle sections of the Barred Rock. Then you will see that type difference is not a question simply of color, but a question of shape and size, and also a difference in muscle texture. Notice the difference between the cross section of the thigh of the White Leghorn as compared with that of the Barred Rock (Fig. 12). That white connective tissue is very tough, whereas the sections in between consist of soft, juicy, red meat, and you will see a greater proportion in the Rock than in the Leghorn. If you were to buy 100 pounds of Barred Rock and 100 pounds of Leghorn as you see them here, take them home, cut off the head and feet and cut it up into parts and prepare it ready for the table, our figures show that you would have approximately 8 pounds more to eat in the case of the Barred Rock originally purchased than in the case

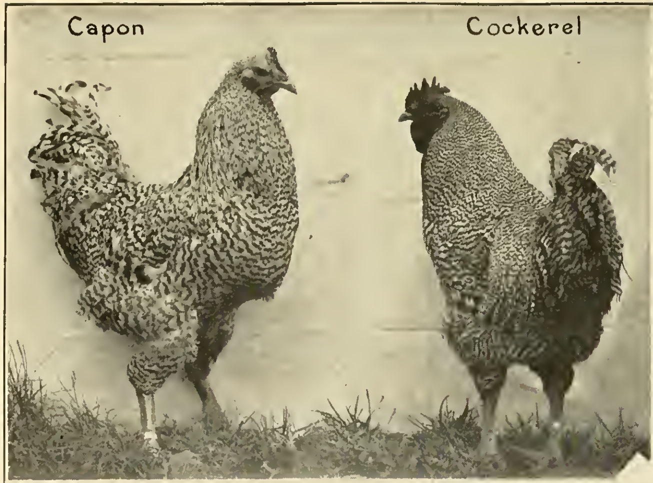


Fig. 6.

a Fig. 7. a a


Fig. 9

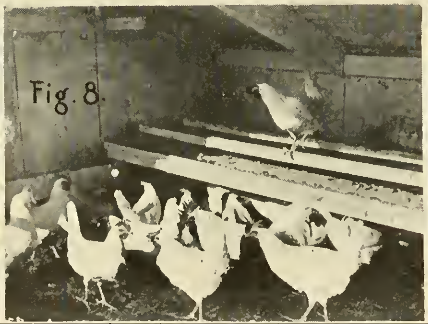


Fig. 8.

Fig. 10.

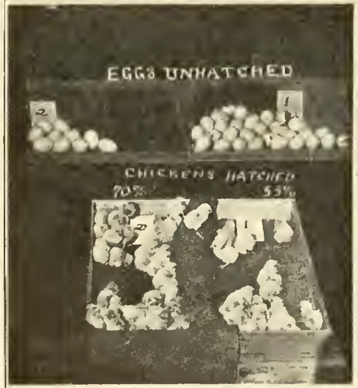


Fig. 11.

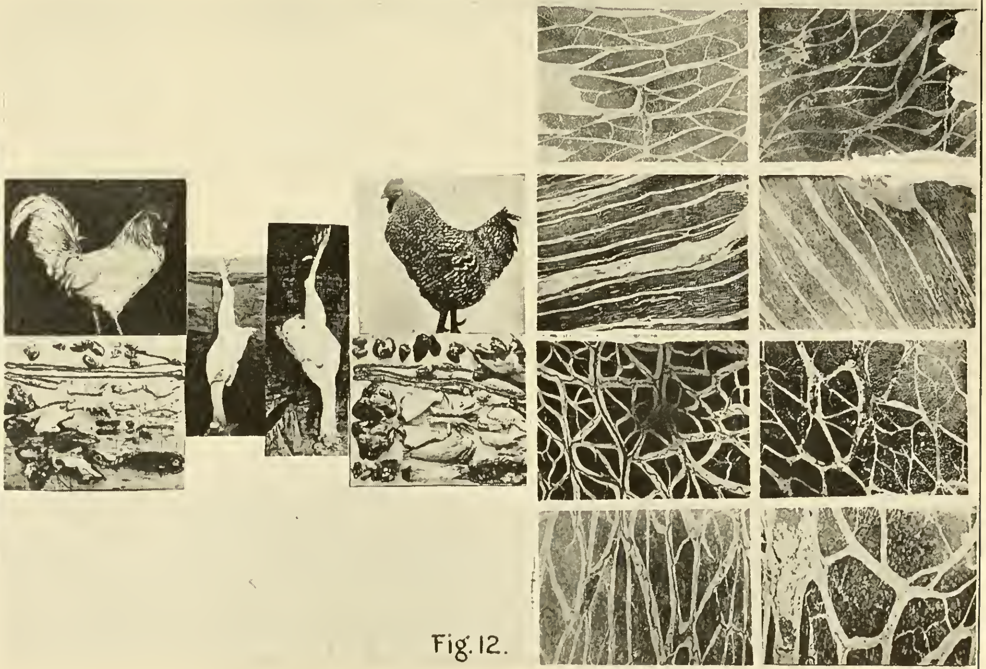


Fig. 12.

of the Leghorn. That means that there is a greater loss in the dressing of the Leghorn than in the dressing of the Rock. But while that is in favor of the Rock as a meat producer and a general-purpose bird, and much to its credit, it doesn't discredit the Leghorn from an egg-producing standpoint, because the Leghorn depends upon its internal machinery to digest food and to lay; it is an egg-laying machine, and it can't be expected to carry a lot of surplus ballast. A Leghorn is also a flying machine, and you know how flying machines are built.

Now let us see what happened, or is likely to happen, when you cross-breed White Leghorns and Barred Rocks. We made crosses for four years of White Leghorns and Barred Rocks, to see whether or not it paid better to cross them than to keep them pure-bred. Now, remember the combinations. There are four of them: two pure-bred, Leghorn and Rock, kept pure, and then two crosses, one the Rock on the Leghorn and the Leghorn on the Rock. Let us see what the results were at the end of the year. We found that the Leghorns laid 121 eggs, the Barred Rock, 88; the cross of the Rock on the Leghorn hen, 119, and the cross of the Leghorn on the Rock hen, 111. The distinction was not very great. In the next generation we found that the straight Leghorn laid us 182 eggs, the Barred Rock, 129, and the cross-bred Barred Rock on White Leghorn, 151, and the cross of the White Leghorn on the Barred Rock, 153. So you will see that our highest egg producer was the straight Leghorn, the lowest the straight Rock and the combination of the crosses was just about halfway between the production of the Rock and the Leghorn. The Leghorn infusion of blood on the Rock increased the production over the straight Rock, but it didn't increase over the pure-bred Leghorn, so we gained nothing in the production and lost the white egg that the New York market wanted and produced eggs that neither New York nor Boston wanted.

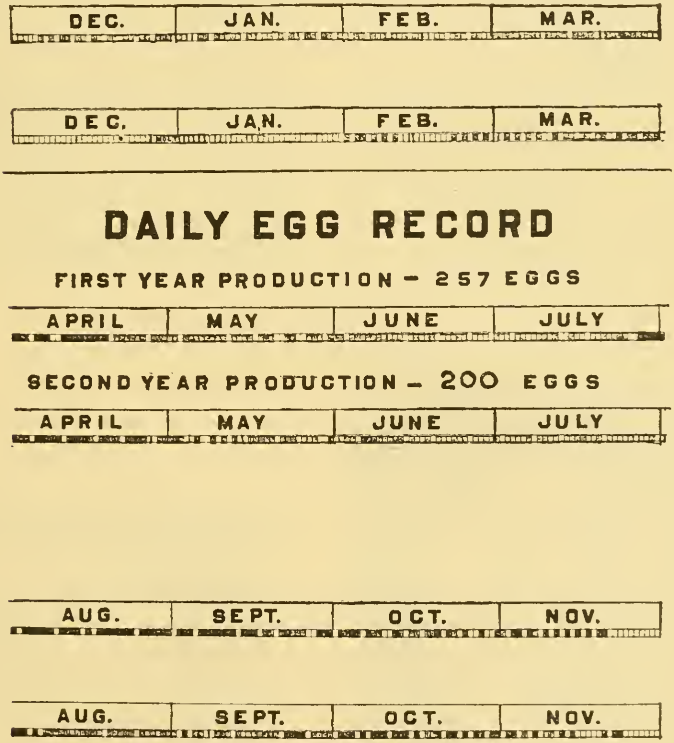
When you come to see how it affected the growth of the chickens, you notice this, that when the chickens were twelve weeks old you could see distinctly the difference in size between the Rock and the Leghorn, and the more they

grew the more striking the contrast became, so that at the time they were seven months old the Leghorn chickens weighed 3.42 pounds, while the Rock weighed 5.05 pounds; the Rock on Leghorn cross weighed 4.35 and the Leghorn on the Rock cross weighed 3.75. In other words, the Rock was the biggest, the Leghorn the smallest and each of the crosses about halfway between the two combinations. So we gained nothing in meat production over the Rocks by crossing with Leghorns, and we gained nothing in egg production over the Leghorns because we lost by crossing with Rocks.

And what did we have in color? Every chick in this cross of the Barred Rock male on the White Leghorn hen was white and shaped like a Rock, both male and female. They looked like the White Rocks with a little deeper plumage, and the reciprocal cross were four colors, some white or nearly so, some barred or nearly so, and combinations between these, slate color and otherwise. Yet they looked like mongrels, and we had lost practically all pure-bred qualities by bringing those two combinations together. It has taken several generations to bring about the development of one of the most magnificent races of egg-producing fowl, — the White Leghorn, — and one of the finest breeds we have in the line of general-purpose birds, — the Barred Rock. When they were brought together it was like Humpty-Dumpty who sat on the wall and who took a great fall, and you know what happened to the eggs, — you couldn't bring them together again. It is like scrambled eggs, they cannot be separated. Keep a breed reasonably pure, but breed them strong.

There is a picture of "Lady Cornell" (Fig. 13), the hen that laid 257 eggs the first year, 200 the second and 191 the third. This pile of eggs (Fig. 14) is not her own laying, but the same number and same size and color, weighing 29.2 pounds. She weighed 3.58 pounds. Think of a little hen weighing 3½ pounds laying 29.2 pounds of eggs in a year! And every time an egg is laid it is no more or less than a reproductive as well as a secretory process. It isn't comparable to the giving of milk on the part of a cow; there is an exact process of reproduction in the laying of the egg, so

that we have a tremendous drain upon the fowl. Here is the food we estimated that she ate (Fig. 15), — more than 100 pounds in one year. This raw material, passing through this vitalized machine in one year, cost $1.66. She was a tremendous eater and must have been in order to lay 257 eggs. As near as we could estimate it — we couldn't get it exactly, but figured on her weight and product and food consumption, and from other figures on other farms — she had produced 72 pounds of voidings (Fig. 16). So you see we have here represented the machine, the raw material, the finished product and the waste material in the process of egg manufacture.



Here is a picture (Fig. 17) of the daily product of this hen for two years. You notice that the top line represents her production, showing that she began to lay December 5 and continued to lay right through December, January,

February and March, and so on, skipping only from three to five days usually in a month, laying sometimes an egg a day for five or six days without skipping. And in April, May, June and July she laid as well as she did in any of the other months. In August and September and October she kept up the good work, and you can scarcely see any let-up in production until November. Then, beginning on her second year, you see she took five or six days' vacation in November, and here, in December and January, did not lay an egg, but was through molting and began laying the first day of February, and got right down to business in good shape in March. Now, following down through April, May, June, July, August, September, October and November in her second year, you see that she was doing approximately as well as she did the first year, and took her vacation again in November at the end of the second year. When we see production of that sort from a high-strung hen we realize her dependence upon regularity of food supply of the right kind, in order to produce an egg every day, or every other day, right straight along, week after week. We realize that if anything goes wrong that hen can't continue to manufacture the product. We must all know the importance of feeding good hens properly.

The following circumstance is an indication of the importance of selecting and keeping late-molting hens because they are usually high producers. We had 100 hens to be discarded for lack of room; from these we selected two flocks of 10 each on the basis of the 10 highest producers and the 10 lowest. The selection was made on the seventh day of November, which is when hens are supposed to be through molting. Here is the result: the ten highest averaged to lay 192 eggs in that year; the 10 lowest producers averaged to lay 28 eggs in the same year. Now, notice the molting condition on the 7th of November. In each one of these cases except three they were in heavy molt. That means that they were pretty nearly molted out; that is to say, the new feathers hadn't come on and they were all ragged. Three of them only were in what you could call advanced molt, — getting ready to get their new feathers, — whereas over here, among


Fig. 13.


Fig. 15.

Fig. 14.



Fig. 16.

these low producers that had laid an average of 28 and none more than 82, we find that all except two or three were new, had on their new feathers, or approximately so, and the others, the advanced ones, were just getting ready to have new feathers come in. So that you can see clearly there the fact that the high-producing hen is one that almost never fails to molt late, and it is almost the exception when the low-producing hen continues to molt late.

Here is a picture (Fig. 3) of Lady Cornell taken the sixth day of December, after laying 257 eggs in a year. She needs a blanket. How many persons would have failed to kill that hen in a flock of hens where all of the others molted early? You would say that she hasn't got the strength to produce feathers. But rags sometimes cover up pretty good quality in the hen race, if not in the human race.

Here is an object lesson (Fig. 18). The hen that we will now discuss had at least 1¼ pounds of surplus fat on her body. You see what a body that is; the fat shows abnormally. We "killed her to save her life." She was worth about $1.25 to sell to somebody to eat. She had a nice red comb, her feathers looked bright and she seemed in good health, but she was so fat that her abdomen pretty nearly dragged on the ground, and I was afraid she would die of fatty degeneration. She was a perfectly normal and healthy hen, but simply over-fat. We found in her a "ready-to-lay" hard-shelled egg, which she would have laid the next hour if we hadn't killed her. I told my wife about it and she said: "That is not very remarkable, I could have told you that before." Well, that is the way the women folks have of doing. They are familiar with the condition of hens in regard to fatness and production, for they prepare the hens before they cook them for our dinners. She said it was very common to find a very fat hen laying. We began investigating the question, and we have examined over 100 hens, and have photographed many of them to see whether there is any co-relation between the fatness of a hen and her laying condition. We never find a hen laying that is poor; we find that a hen lays best when she has surplus fat and frequently large quantities of it. We find more mistakes are made in

feeding hens by underfeeding than by overfeeding. The great point is not only to feed the right kind of rations, but to give them enough to eat.

Now, let us get a little better proof. That is just one hen, and one case does not establish a law or a theory. One day we were killing 40 or more hens that had been fed alike, and all of the same breed. We wanted to see how they compared in fatness and production, and we photographed those hens after they were killed and cut open properly, so as to show their internal fat in the order of their fatness. You will see in the illustration (Fig. 19), the three fattest hens on the left and the three leanest on the right, their organs under them. The three fattest hens all had eggs fully formed, hard-shelled, ready to be laid. The oviducts showed that they would have gone on laying for weeks to come. The three leanest hens were absolutely dormant. You can feed hens so much of certain kinds of food that they will be lazy and phlegmatic. You can underfeed them so that they can't lay or even maintain themselves. The rule should be to give hens all they can eat of the right kind of food at least once or twice a day, and make them come hungry to the third feeding. When they show that they are hungry enough to want to eat more by coming to meet you, then you know that they have made good use of the food. A hen has difficulty in eating too much of any dry, fine food, even though it is before her for half the day; consequently, we have come to adopt the rule of letting the hens eat all of the ground food they want each afternoon, and then giving them a little grain in the morning to keep them busy, and at night giving them what they will eat up clean. Following is the Cornell ration for egg production and the method of feeding and its results: —

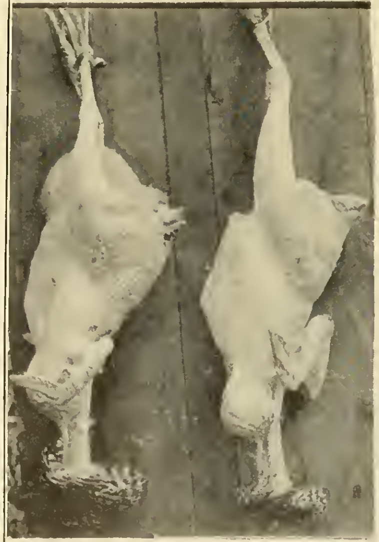


Fig. 18.

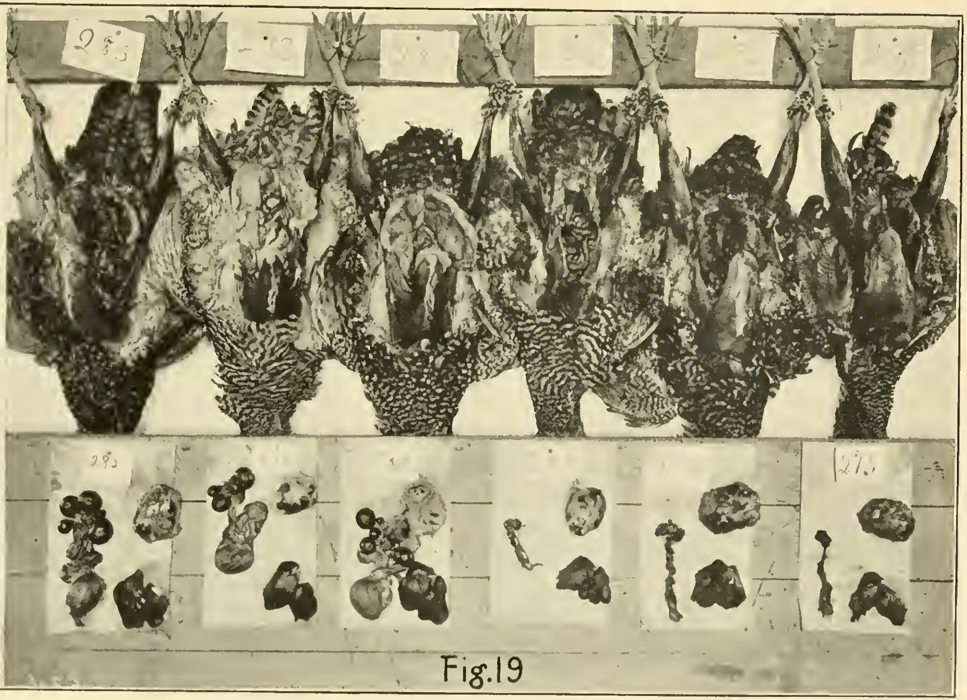


Fig. 19

Cornell Rations for Laying Hens.

The following whole grain mixture is fed morning and afternoon in a straw litter: —

Winter.

	Weight (Pounds).	Measure (Quarts).
Wheat,	60	32
Corn,	60	36
Oats,	30	30
Buckwheat,	30	20

Summer.

Wheat,	60	32
Corn,	60	36
Oats,	30	30

The following mash is fed dry in a hopper kept open during the *afternoon only:* —

Winter and Summer.

	Weight (Pounds).	Measure (Quarts).
Corn meal,	60	57
Wheat middlings,	60	71
Wheat bran,	30	57
Alfalfa meal,	10	20
Oil meal,	10	8
Beef scrap,	50	43
Salt,	1	½

The fowls should eat about one-half as much mash by weight as whole grain. Regulate the proportion of grain and ground feed by giving a light feeding of grain in the morning and about all they will consume at the afternoon feeding (in time to find grain before dark). In the case of pullets or fowls in heavy laying, restrict both night and morning feeding to induce heavy eating of dry mash, especially in the case of hens. This ration should be supplemented with beets, cabbage, sprouted oats, green clover or other succulent food, unless running on grass-covered range. Grit, cracked oyster shell and charcoal should be accessible at all times. Green food

should not be fed in a frozen condition. All feed and litter used should be strictly sweet, clean and free from mustiness, mold or decay. Serious losses frequently occur from disease, due to the fowls taking into their bodies, through their intestinal tract or lungs, the spores of the fungus causing molds.

Results at Cornell, 1909–12, three-year record: 15 highest producing pullets averaged 236 eggs each; best single-flock pullets averaged 182 eggs each.

Egg Record of the Four Highest Producing Hens.

Date Hen laid First Egg.	Hen Number.	Name.	Eggs laid First Year.	Eggs laid Second Year.	Eggs laid Third Year.	Total Eggs laid in Three Years.
Dec. 6, 1909	3211	Lady Cornell, . . .	257	200	191	648
Nov. 24, 1909	9363	Madam Cornell, . .	245	131	163	539
Dec. 4, 1908	1463	Cornell Surprise, . .	180	186	196	562
Dec. 10, 1910	3418	Cornell Supreme, . .	242	198	225	665

Just a word in regard to the development of the egg. On the spine of the fowl is a cluster of ova (Fig. 20). According to Dr. Pearl there are as many as 1,500 to 3,000 of these within the normal hen. Some of these never develop, some hens never lay, and yet they may have just as many undeveloped ova as good-laying hens; others have the tendency to develop eggs with great regularity when conditions are right, so that when they are fully ripe the yolks break from the follicle, fall into the ovisac and pass on into the oviduct, where the process continues and the white is laid on, until they get down, in about four to six hours, where the shell membranes are put on, and then they move downward a trifle more, where they stay about twelve hours and the shell is laid on. Now, then, the point I want to make right here is this, — if you don't feed hens the right kind of food and enough of it, they can't have that surplus fat in their bodies which is necessary to make the first part of the egg, because the yolk of the egg is the first part made. The yolk contains 65 per cent of dry matter, which is fat, and is about the only fat in the egg. Don't you see that unless the hen has that surplus energy stored up, that fat stored up, she can't

make the ova, — the first part of the egg, which is more than half the fat? Therefore we find that when a hen is about to begin to lay, she will begin to eat heavily three or four weeks before she lays, because all that time she is storing up surplus energy — food value — in the ova, ready to lay.

Now, on this slide (Fig. 21), you will see that muscle tissue magnified 25 times when put under a microscope, and you can see the ova pretty nearly ready to break through. Here is a fact that ought to startle us: a hen, apparently, may be in the finest of laying condition, laying eggs every day right along, and then something happens that frightens her and interferes with her digestion. A bird cannot eat and digest well when it is frightened or when something is going wrong. She may not have enough to eat or enough to drink, or there may be an excessive cold snap, or something of that kind, that strikes her and she suffers physically, and that causes a failure of thorough development in the ova. Then what does she do? She simply draws on that surplus food in the ova to sustain her, and she reabsorbs it, *i.e.*, she uses up eggs that would have been laid, and perhaps worth 50 to 75 cents a dozen, if nothing had happened and she had gone on laying. In other words, she will take that extra nourishment right back and use it for food. Don't you see, then, the importance of having everything right, so that when a hen begins to lay she can continue, and not use up that nourishment to keep warm which she ought to be putting into eggs? It is a vastly easier thing to stop her laying when she wants to lay than it is to start her when she doesn't want to. We know this; we don't guess, as is shown by the following: Dr. Riddell of Chicago University discovered a harmless aniline dye called "Soudan–3," which you can feed to hens in little capsules, one a day or one in two days, and which will color the fat that went into the hen's ova during that day and will not color the fat that was in there the day before or that is deposited the day after. Consequently, the hen that laid this egg, of which this picture (Fig. 22) is a cross section, was fed every other day, and you will see that the yolk was this much bigger, a ring each day, — so that counting up to six rings and multiplying by two, because the color was fed

every other day, you will see it took twelve days for the yolk to get from the size of a small bean to a full-sized yolk ready to be laid. That took twelve days in this case. It takes from twelve to fourteen days generally for a hen to manufacture a yolk from the size of a small pea up to that of the yolk ready to be laid, and it takes about eighteen hours from then to make it up into the full egg with the white around it and the shell put on.

This picture (Fig. 22) shows a flock of Plymouth Rocks put into a house as pullets when they began to lay, and a board floor put on the earth so that they couldn't get to the ground to get gravel or soil, but were fed on the regular ration, with just one exception, — that they received no bone nor any oyster shell. They had no lime other than what was in the ordinary grain. They had mica spar cubical grit which contained no lime and simply had the ordinary grinding value. We noticed this, that the very first eggs these hens began to lay were soft-shelled eggs, and the first egg that they laid they ate, and they continued to eat every egg they laid, if they could find them before we did, as long as they were fed that kind of feed, and that was eleven months. We lost 70 cents a year apiece on those hens. A very interesting situation developed also. The hens were ravenously hungry for food that they could not find. Their instinct told them the things that they liked in the food and needed in order to lay. If a hen happened to lay an egg all of the other hens would immediately pounce upon it. They were so hungry for those eggs that the only eggs we could get we induced them to lay in a little box with a hole in it, with a glass egg fastened so that they thought everything was all right, and I have seen the hens up on one of the nests waiting for another to lay so that they could get the egg before it got down out of their reach. One laid an egg that got away from her and she went head first into the hole, but it got away. She was so mad that she was red in the face.

We took six of those hens, — we killed part of them to see what was inside, — and we put the six into another pen and gave them all the oyster shell they wanted to eat, but fed them on the same kind of ration otherwise. They im-

mediately improved physically. We gave them what they wanted in the way of lime. When we cut them open we found all of the hens, except just one out of the six, in full laying condition, and all laying hard-shelled eggs, and none of them eating their eggs. Egg eating is a vicious habit they are liable to contract, which you may never cure. However, these did not continue to eat their eggs, but they continued to lay and they laid hard-shelled eggs. They need an enormous volume of grit to do their grinding.

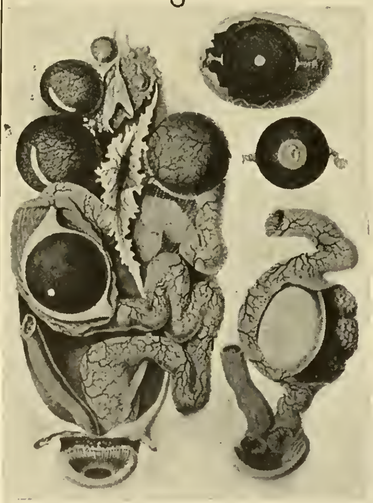
In another experiment, which I cannot at this time discuss, we fed the hens powdered oyster shell as compared with whole oyster shells and various combinations of that sort, in which we found that even if they had all the lime they wanted they also required grit. They need sufficient grit to crush their food, to macerate it, in order to get the most digestive value. They need grit to grind their feed as well as lime to make the egg shell. Sometimes that little lack of limestone, broken oyster shell, clam shell or something of that sort, is the one factor that stands between reasonably good egg production and poor production; and oyster shell only costs 50 to 60 cents a hundredweight.

Figure 24 represents a feeding experiment in which four different types of ration were fed for three years to the same flock or flocks of hens. The first flock was fed a grain mixture, — corn, oats and wheat, — and ground mixed feed, consisting of corn meal, wheat bran, wheat middlings, and so forth, and meat scraps, fed as a wet mash. The second flock was fed the same kind of grain, same kind of ground feed, and the same kind of beef scraps, only fed dry in a hopper where they could eat what they wanted to at any time, and the grain was fed in a litter out of hand the same as it was in the first pen. The third pen had the same kind of grain as each of the other two, and the same kind of meat scraps, but the grain was fed out of hand and there was no ground feed. The fourth pen had exactly the same treatment as the third, except that they could eat out of a hopper whenever they wanted to, and they had no ground feed. Let's see what the result was in three years' time. Our best results were in favor of the grain morning and night in the litter,

and the ground feed with meat scraps in it in a hopper where they could eat during the afternoon; the next best result was where the hens had a wet mash and the ground feed; the next, where they had a grain feed out of hand; and the poorest result, where they could eat grain whenever they wanted it. The natural conclusion, therefore, is that it is desirable to give hens ground feed in the hopper, dry, and feed grain out of hand night and morning.

I shall have to pass one or two of the slides, only pointing out briefly what they are intended to show: first, the desirability of a concrete floor and foundation in a hen house; second, the desirability of having some sort of wallow where they can free themselves from vermin in a dust bath, located where they will not have to breathe the dust in the air that is made by other hens; third, that there should be a broody group in each house, where they can be quickly placed and cared for, because that is the way they can be broken up in a hurry, and also a place for surplus males; and fourth, there should be the open-air type of house, whatever style may be desired. There are many different good ones. One little principle in making a poultry house wall which we find exceedingly effective in our State is to have a double board directly back of and above the place where the chickens roost. This slide (Fig. 25) shows the interior of a house. Here at this point is a double boarding extending down below the platform that catches the droppings, opening between the studs at the bottom, and at the top, between the rafter just above the place where they roost, so that there is a circulation of air and no dead air space between these two walls. All the rest of the house may be single boarded. It is simply a question of making the place where the hens roost warm and dry, because the air that circulated through this house around between those two walls keeps this wall from getting cold, and consequently prevents condensation of moisture, and is a very cheap and exceedingly effective way of keeping the place where the hens roost warm and dry. We also believe that heat in the summer is quite as serious a fault as excessive cold in winter, and that hens fail to lay in the hot summer weather quite as much as in excessive cold

Fig. 20.



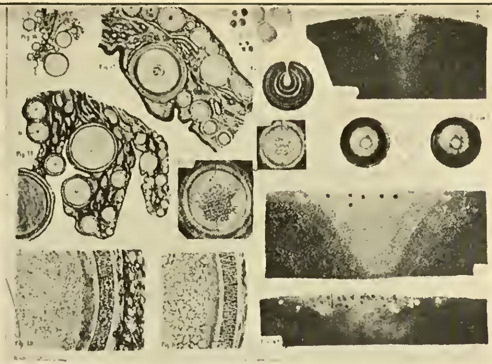
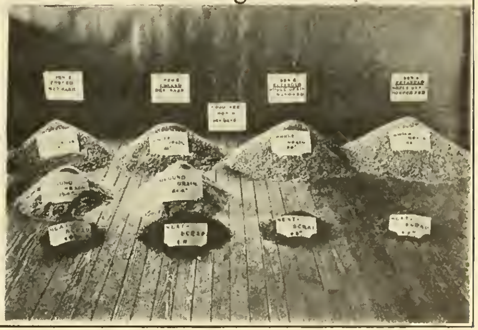


Fig. 21.

Fig. 22.

Fig. 23.

Fig. 24.



weather, so that in order to keep the hen house comfortable there should be upon the north side some sort of hinged door which could be opened in the summer to let the air circulate through without making a draft on the hens, and which could be shut down in the winter so as to have it absolutely tight on the coldest side.

I want to call your attention to the variation in egg production each month in the year between the United States and Australia, to show how the climate affects production (Fig. 26). There are plotted the curves of production for the months of April, May, June, July, August and September, across the cut over to April the following year. They show how Australia's lowest production is in April, May and June, how it goes up in July and August, is highest in October and November, and begins to go down in December, January and February to this point, while all of the lines on the lower side represent the curves of the fluctuation in production each month for eight or nine flocks of fowl in New York State, showing that our production is almost identical with that of Australia in April, May and June, but in July, August and September will go down, and is lowest in October, November and December, whereas in Australia, exactly on the opposite side of the earth, they are highest during those same months. It is simply a question of climatic conditions.

Dr. Stimson of our college has made temperature examination of a great many hens and compared the temperature of the hens in each month with the temperature of the weather, the length of the day in sunshine, the egg production, and so forth, and he finds that as the temperature of the weather changes, covering a period of two years, the temperature of the fowl goes up or down slightly, according to the warm or cold months of the year. The same is true as regards hours of sunshine each month of the year, from the lowest in winter to the highest in summer. So you see the hen is a creature of circumstance who responds to her environmental conditions.

Selecting eggs for hatching and keeping them in the right way for the right length of time is of great importance. A

couple of our students last year repeated an experiment which we have done now three years in succession with almost always the same result, of keeping 100 eggs in each box similarly selected from the same breeds of fowl, keeping them one day, seven days, fourteen days, twenty-one days, twenty-eight days and thirty-five days, all in the same room and at temperatures varing from 48° to 52° and 75°. So they were all kept under identical conditions. Now, let us see how the length of time we keep our eggs affects their hatching powers. Those eggs kept thirty-five days, 46 per cent hatched; twenty-eight days, 46 per cent; twenty-one days, 84 per cent; fourteen days, 90 per cent; seven days, 92 per cent; and one day, 93 per cent. What was the percentage of fertile eggs hatched? For those from one to thirty-five days, 1, 6, 17, 47, 45 and 68 per cent. Does it pay to keep eggs for hatching any great length of time? In other words, we can lose vitality in our eggs by simply holding the eggs a little too long or under improper conditions.

I must apologize to you for not being able to get entirely through with my subject, but I have done the best I could in the length of time I have had. I thank you.

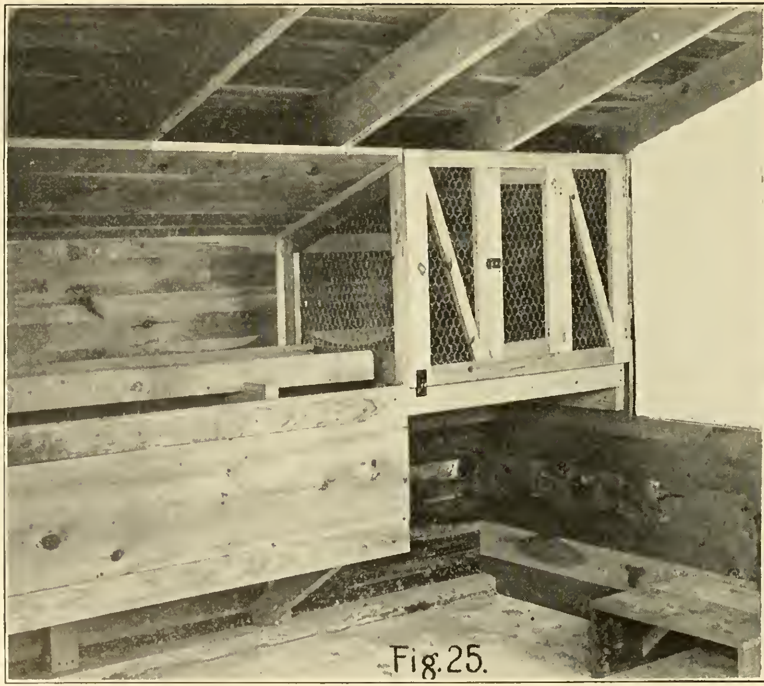
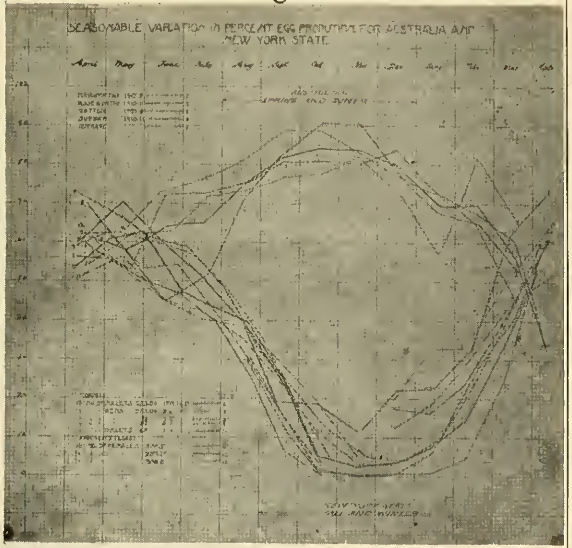


Fig. 25.

Fig. 26.


SEASONABLE VARIATION IN PERCENT EGG PRODUCTION FOR AUSTRALIA
NEW YORK STATE

GROWING SMALL FRUITS AND BERRIES.

WILFRID WHEELER, CONCORD, MASS.

Probably no group of fruits can be grown over as wide an area geographically as the so-called small fruits; neither does any other group lend itself to such a variety of cultivation as regards soil, climate and other conditions. Some member of the group may be found in practically every country in the world, either in cultivated or native form. The strawberry in particular grows over a larger range of territory than any other known fruit, and seems to be able to withstand great extremes of heat and cold. While other members of the group do not lend themselves so readily to change as the strawberry, yet they are found in many different parts of the world.

Here in Massachusetts we are particularly favored in having conditions favorable for the growing of all the small fruits, and not only for growing them but for marketing them as well. No section of the country has better soils and climatic conditions. We have large and small farms splendidly adapted to producing any or all of these fruits, while our great number of cities and prosperous towns give us a market for our product which is unequaled in this country. Our transportation facilities are good, and there are but few sections where there is not a good outlet to a market. Another factor for the encouragement of the small fruit grower is the increasing demand for these fruits by the visitors to hotels and summer resorts, so that while many farms may be situated away from a city market, still there is always an opportunity offered by the summer boarder which should be met by our farmers.

Another element which will attract more people into the business of small fruit growing, and which will become an

industry by itself, will be the local canning and preserving establishment. Already New York growers are realizing the great value of such places and are establishing them in sections where large quantities of fruit are grown. These factories have proved of great value to the farmer and are also safe business ventures. In New York, where many acres of currants are grown, the factories take all the product at 5 cents per pound, thus netting the growers about 5 cents per quart, which is a far better price than 8 cents per quart when the fruit is placed on the market, for the factory requires no special package, there are no commissions or express charges to pay, and the whole matter is in the growers' control. In England, where more small fruits per capita are grown than anywhere else in the world, the growers very often own or control the packing houses, and as we come to make more of a business of this sort of thing such results are sure to come here.

We have got to make people understand, educate them to see, that quality, which means, largely, freshness and the right state of ripeness, is of primary importance, and therefore if fruit can be bought near at home it is more likely to have quality and to be cleaner and freer from dangerous germs than that same fruit carted over dusty roads to a city market and brought out again to the country on the railroads; and what is true of fruit which is to be used fresh is also true of that which is to be preserved.

Make-up of the Group.

The group of fruits commonly known as small fruits consists of the strawberry, gooseberry, raspberry, blackberry and currant, while some fruits of lesser importance are sometimes listed in this group, namely, the wineberry, blueberry and Logan berry, but their cultivation is as yet so limited that it is not well to discuss them in a paper of this kind; however, we hope to see the day when many of our now wild fruits will be improved and cultivated and added to the group. Certainly the day is not far distant when we shall see the blueberry in common cultivation; indeed, the government has considered this berry important enough to publish

a bulletin on the subject of its cultivation. One thing very necessary to success with these small fruits is a strong love for the business; indeed, no calling in the world demands the entire interest of the man at the head so much as farming, and especially this form of fruit farming. There are so many details and so much close, exacting work connected with it that the person who is used to farming with large machinery is apt not to make a success of small fruit growing.

Selection of Location.

Those of us who have farms in well located places can decide whether or not we care to grow these small fruits, — that is, whether or not we are adapted to the business or the business to us; but to those selecting a new location a few essentials are very necessary for success. First, we must be reasonably near a market, or we may be a good way from a market, providing we have first-class transportation facilities. Cape Cod is not considered near the Boston market, yet strawberries from its extreme end are sent to Boston as quickly and as cheaply as from points under 40 miles, and, furthermore, the fruit arrives in as good condition. This is chiefly due to the different method of transportation, for while the cape depends on the railroad, the nearer places depend on horse-drawn vehicles.

There is an ever-increasing demand for Cape Cod land for the growing of the strawberry, not only because the land is cheap and good, but because berries grown there are much earlier than those in other parts of the State, and fruit of the choicest varieties can be produced and delivered in Boston from one week to ten days earlier than from localities west or north of that city. I have seen cape berries selling in Boston on the 7th of June at 50 cents a quart, while no other native berries appeared until the 17th of June. Such points as these should be carefully considered before locating to grow small fruit crops.

The land itself should be what is commonly known as good corn land, and if all varieties of these fruits are to be grown, a part of the land for currants and gooseberries should be fairly heavy and moist; indeed, moist conditions are very

essential and should be looked into carefully, for while a fairly dry soil will grow good plants, it is unable to carry through the crop at picking time if the weather happens to be at all dry. In such cases some form of artificial irrigation will have to be employed. This will make an added expense and is not necessary, provided the right land is chosen in the first place. Soils can be improved, a wet soil drained by the use of tiles and stone drains, and a dry soil made moist by cultivation and the addition of some form of humus. One form of soil to be avoided in the cultivation of small fruit is that where hardpan is very near the surface. If there is hardpan 3 or 4 feet below the surface, so much the better, as this is a moisture-retaining subsoil, but it should never be nearer than 2 feet to the surface. Sloping land bearing to the east or west is to be preferred to that bearing north or south. The slope serves to drain surplus water during the winter and spring. A gradual slope is better than a steep one, as the latter is so apt to wash during the spring rains. One of the worst places to plant small fruits, and in particular the strawberry, is on land where there are many small depressions which have no chance to drain.

One very important matter to be considered in the growing of small fruits is that of pickers, for as these are very perishable crops, and must be handled quickly, we must have an abundance of good help near by, although now, with the motor truck as a factor in handling both crop and help, this need is not as important as it used to be. Some growers are now bringing their fruit pickers 20 miles by motor, returning them to their homes at night, using the truck between times to get the fruit to market. As we build better roads and open up more country, the question of handling our crop is going to be solved very well by the use of the motor truck, and we may look forward to the not distant future when this vehicle will be the means of taking our products direct to the door of the consumer, thus eliminating the rather expensive middleman.

One thing is very certain, and that is, that compared with the consumption of small fruit abroad, our people are not using enough here, and it should be our endeavor as growers

to solve this problem by producing better and more attractive fruit and by packing and placing the fruit on the market in a much more inviting condition.

Think of the difference in the consumption of oranges during the past few years! Since the growers of this fruit have been organized and awake to the situation, they have more than doubled the number of oranges used, by judicious advertising backed up by a uniform product and an honest package.

Preparation of the Soil.

No crop on our farms needs a better preparation of the soil than small fruits, for, in most cases, and especially with the strawberry, the roots are very small and fine and need the most carefully pulverized soil in order to get their best growth. Sod lands should be broken up at least one year before planting the crop, and if there is any witch grass or other perennial weeds, great care should be taken to destroy them, for nothing will run out a plantation of currants or gooseberries quicker than to allow witch grass to come in. A well cultivated crop, like corn or potatoes, should precede the small fruits on newly turned sod land, but they can be planted successfully on any well prepared farm lands. Asparagus beds which have run out, and which have been kept free of weeds, are splendid places on which to plant the strawberry, raspberry or blackberry, while the currant and gooseberry will follow very well after any of the root vegetable crops, as carrots, parsnips or beets; in fact, market-garden crops can be grown for two or three years among currant bushes, provided, however, enough fertilizer is added to support both crops. It must be always kept in mind that all small fruits are gross feeders, and an abundance of fertilizer must be added to the soil if good results would be obtained. In the first preparation, it is always well to apply plenty of manure, as this insures a quick, sturdy growth, as well as supplying a water-holding condition in the soil without which the crop might suffer in a dry season. Leguminous plants, such as clover, cow peas, vetch and soy beans, can be turned under in places where manure is scarce, and this will supply to the soil practically the same elements as ma-

nure. At the time of planting, and during the first growing year of the plants, applications of fertilizer should be made at intervals of from two to four weeks, using small amounts and immediately cultivating it in. With the strawberry, care should be taken not to apply an excess of nitrogen near the fruiting season, as the result will be soft and rather insipid fruit.

The bush fruits require an abundance of manure applied in the fall or very early spring. This can be supplemented in places where manure cannot be found by bone meal, tankage, muriate of potash and slag. Where bush fruits are grown among larger fruit trees, care should be taken to see that enough fertilizer is applied to supply both crops.

Planting.

In this State planting of nearly all the small fruits should be done in the spring, with the possible exception of the strawberry where grown as a garden fruit on a small scale; this can be planted in the summer and fall with good results. Planting in the fall of gooseberries and currants is practical, provided the bushes do not have to be moved a great distance, and it will also be necessary to plant a little deeper at this season of the year in order that the soil may be heaped up about the stem of the plant to protect it during the winter. Distances will vary according to varieties and location. Certain kinds of currants, like Cherry, can be set 4 by 4 feet, while others, like Perfection, will crowd at 6 by 6. Some strawberries, like the Bubach, which makes few plants, can be set 3 by 1, while others, like the Senator Dunlap, will cover the ground when set 4 by 3; but the usual distances in the following table will suffice for most planting: —

Strawberry: —	
Matted rows,	4 by 2 feet
Hills,	14 by 14 inches
Currant,	5 by 5 feet
Gooseberry,	5 by 5 feet
Raspberry,	6 by 2 feet
Blackberry,	6 by 2 feet

In all planting great care should be taken to have the rows straight and the same distance apart. The bush fruits should be set in check rows so that cultivating can be done in both directions until the growth of the bushes prevents. In all these plants the roots should be slightly shortened before setting, and the soil firmed hard about them in order that no air be left to dry the roots. In dry weather it is always best to dip the roots in water just before setting, and if no rain comes within a few days, water should be applied about the plants. Cultivation should begin as soon as possible after the plants are set, never letting this important operation go for more than a week. On a large scale cultivation should be done with horse tools and in small plantings by wheel hoe and hand. Cultivation is one of the most important operations in the growing of small fruits, as it not only is a means of destroying weeds, but serves as the most direct way to conserve ground moisture. There are various types of cultivators on the market, but the best for this sort of work is one that has a fair number of rather short, fine teeth. It is not necessary for the cultivator to go deeply into the ground, especially when cultivating the strawberry, as the roots of this plant are fairly near the surface, the main object being to keep the top soil well stirred in order to form a dust mulch. The plow should never be used among currants or gooseberries, but sometimes it is necessary to run the plow beside the rows of blackberry or raspberry in order to cut off surplus suckers. Cultivation with the strawberry should be carried on throughout the season as late as the middle of September, but with the bush fruits it should cease about the 10th of August, when the land can be sown to oats or buckwheat and the stubble of their crop left on the ground for a winter mulch. There is some danger from this mulch among currants, for if it is at all heavy mice will get in and destroy the bushes, so care should be taken not to sow too heavily or too early. Winter protection for the strawberry is very necessary, but the covering should not be too heavy, nor applied too early. Generally speaking, the first week in December, when the ground is frozen a little, is the best time for applying this cover, which may be of leaves,

pine needles, coarse strawy manure, or, best of all, cheap meadow hay or cut grass. This latter does not mat down too closely on the plants, and when held in place by brush or trash wood it makes an excellent mulch. It is well to bear in mind that this mulch is not intended to prevent the ground from freezing, but rather to keep it frozen until late in the spring; indeed, the mulch is of more value during the month of March than at any other time, for it is then that the unmulched strawberry bed is injured the most by the alternate freezing and thawing of the soil. The mulch can safely be removed in this vicinity about April 10. In some cases where plants are not required from the bed, and where the ground is free from weeds, it is best not to remove all the mulch, but rather let the plants grow up through it in order to save the extra work of replacing a mulch about the plants at picking time to keep the ground moist and the fruit clean.

None of the other small fruits need winter protection, with the possible exception of the raspberry, which, in some places, winter kills when not laid down. If it is necessary to lay the canes down, this should be done the latter part of November before the ground freezes, but care should be taken to uncover them before the buds start.

Pruning.

This is a very necessary operation, especially with the bush fruits; the currants and gooseberries in particular should be carefully attended to, for the size of the fruit and the continued life of the bush depend very much upon this important operation. All wood three years of age should be removed, as we get our best fruit in both currants and gooseberries on the one and two year wood. The center of the bushes should be kept open. Generally speaking, about two-thirds of the new wood should be removed in order that what is left may make a good sturdy growth.

With the raspberry and blackberry pruning consists largely in removing the wood which has borne a crop, but the canes should all be cut back in the spring to about 4 feet, as the best fruit comes from the large buds near the heavy part of the cane. Summer pruning should also be

done to some extent, and consists largely in removing weak shoots and pinching back long ones so that the strength of the vine shall go to developing large fruit buds. An excessive growth on either the raspberry or blackberry is to be avoided, for generally this is a soft growth and is more liable to winter injury than when the growth is medium and hard. Raspberries and blackberries often need to be tied up to some kind of a trellis, but this is not necessary if the proper pruning is done, although some varieties grow such a slender cane that they have to be supported.

Spraying.

All of the small fruits should be sprayed, not only for insect pests but for the various plant diseases which attack them, in order to get the best results.

Currants and gooseberries are attacked by the San José scale, and once the bushes get badly infested it is better to dig them out and start over, for this pest is hard to get rid of in currant bushes; oil is by far the best spray for scale on currants and gooseberries, and great care should be taken to apply it well about the base of the plants near the ground, for the scale often gets below the surface on the stems of the plant, and is difficult to reach with anything that will not creep or spread as the oil does. Spraying for scale should be done in the fall with oil, and, in bad cases, again in the spring with lime and sulfur before the buds begin to swell. Currants and gooseberries should also be sprayed for currant worm soon after the leaves are well out, and if this is done early enough arsenate of lead can be used, but if the spraying is left until the worms appear a quicker acting spray like Paris green should be used. Probably one of the worst enemies of the currant and gooseberry is the aphid or plant louse. These insects appear in such numbers that the leaves on the ends of the shoots are quickly rolled up, and then there is no chance to fight the pest. Spraying for the aphid should begin as soon as the growth begins on the plant. Some of the tobacco products are the best sprays to use in fighting this pest.

The raspberry and blackberry do not have many insect

pests which can be attacked by spraying; in fact, with the exception of the gypsy and brown-tail moths, they are pretty free from leaf-eating pests, but the cane borer which does considerable damage on old plantations is a hard insect to fight and can only be controlled by removing the canes which show signs of dying after they leaf out. Spraying for leaf rust with Bordeaux mixture is as yet the best method of controlling this rather serious pest on blackberries and raspberries, but in very bad cases it is far cheaper to cut the plants down entirely and start fresh in new soil and with new plants. Root gall is more or less serious on raspberry plantations, and here, again, the site should be changed and new plants free from this pest planted.

Anthracnose, a common disease among raspberries and blackberries, can be controlled by spraying with Bordeaux. In fact, many troubles with our bush fruits can be controlled by this excellent spray material. One very important factor in the control of diseases and insects among these fruits is cleanliness. The ground should not be allowed to grow up to weeds and grass. Fence corners and walls near the plantations should be kept clean, for often our worst pests, both insectivorous and fungicidal, live over winter in places where refuse is allowed to collect.

With the strawberry, spraying should be done to control leaf blight, and early sprayings just as soon as the new leaves appear will do more good than when the blight appears; in fact, spraying in the very early spring the dead foliage of the previous year's growth will often check an attack of leaf blight.

There are very few leaf-eating insects which attack the strawberry, with the possible exception of the cutworm, which can be controlled by spraying with Paris green. Probably the worst pest of the strawberry is the common white grub. This insect attacks the roots of the plants, and does great damage before its presence is noted. Practically the only way of controlling this pest is by rotation of crops, so that strawberries do not follow strawberries more than two years on the same land; neither should they follow potatoes or clover.

Spraying outfits for small fruits need not be elaborate. For large fields of strawberries a potato sprayer works very well, while for bush fruits the barrel sprayer is sufficient for areas up to 10 acres. For small plantations there is no better outfit than the knapsack sprayer. The disc nozzles are best for bush fruits, while the Bordeaux is best for strawberries.

Picking and Marketing.

These are the most important operations of all, for, while great care may have been taken in the growing of the crop, if the same or greater care is not exercised in the picking and marketing, good fruit may be ruined and the result of a year's labor lost.

With the strawberry for local markets, the berries should be allowed to ripen thoroughly on the vines, but for long shipment they should be picked before they begin to soften. There is always a period of ripeness between the time a berry turns red and the time it begins to soften, and it is only by experience that one can tell this, so it is necessary to go over the beds at least once a day and select all specimens which are in one of these two classes. All sorting should be done at the time of picking, as the strawberry does not stand up well under table sorting. Clean, new packages should be used and the No. 1 berries should be marketed in a different type of package from the No. 2. A very convenient package for the best berries is the 18 or 21 quart tray or 16-quart crate. The second-grade berries can be handled in the 32-quart crate. It is always a good idea to have some distinctive label for all fancy fruit, and this label should bear the name of the grower, together with a statement of the contents of the package, and in all cases the contents should stand up to the label. We farmers have got to guarantee our product just as much as the manufacturer does his goods, and the sooner we pack an honest package and so label it that the buyer knows what he is getting and can rely on the statement on the label, just that much sooner may we hope for an increased demand for our products and a satisfactory price for them.

It is very necessary to instruct pickers in handling these

small fruits carefully, as the slightest bruise on such tender fruits as the strawberry, blackberry and raspberry will show, and decay will quickly begin. As a rule, men are better than children for this sort of work, but it may be necessary to employ any kind of labor one can get, in which case the grower will be put to it to devise means of having his fruit handled with care.

Raspberries and blackberries should be marketed in pint boxes, while strawberries, currants and gooseberries can be shipped in quart baskets.

Your market will depend largely upon yourself. Whether you care to develop your local market, or whether you intend to ship to the large, near-by city, is a matter which will have to be decided by the individual. We would like to see a greater development of the local market in order that people may get a better product direct from the producer, and thus use more of it. On the other hand, where it is possible to use a motor truck and make at least two deliveries a day, the large city market can be used to very good advantage. It is always best to avoid as far as possible the shipment of strawberries and raspberries by express, as the rough handling which they get usually places them on the market in very bad condition, and the grower will have to take a reduced price for them. Having developed your market, try to keep it supplied, as long as the season lasts, with your products, so that customers may call for yours and be sure of getting them.

Varieties.

Certainly one of the most important points to consider in the planting of small fruits is variety; not as important as with the larger fruits because our plantings are more temporary, but still, if we would succeed nothing counts like variety. Cape Cod has made its reputation in strawberries on the Marshall berry; New York, its reputation in currants on the Fays, and so on; and while we know that one variety of the strawberry will do better in some locations than in others, when we have found a variety that suits a locality we should stick to it and make our reputation with it. It is practically impossible for me to tell you what will succeed

best on your farm. We can only give you the names of those varieties which have succeeded in Massachusetts, and it will be necessary for the beginner to try out some of these until he finds those best suited to his conditions: —

Strawberry.

Marshall, Senator Dunlap, Barrymore, early.

Sample, Minute Man, Downing's Bride, Glen Mary and Wooseter, midseason.

Golden Gate, Stevens Late Champion, Heritage and Brandywine, late.

During the past few years there has been developed a new type of strawberry known as the overbearing strawberries. These berries have certainly proved their worth and are true overbearers. Most of them begin to fruit about the 1st of August and continue to bear until late in October, and while they may not become commercially profitable, still they are valuable for the home garden and to some extent commercially. The best varieties are Pan American, Superb, Productive and St. Louis.

Desirable Varieties.

Currants. — Fay, Perfection, Wilder and White Imperial.

Gooseberry. — Downing, Columbus, Chautauqua and Industry.

Raspberry. — Cuthbert and Herbert (red); Yellow Queen (white); Plum Farmer, Kansas and Cumberland (black).

Blackberry. — Eldorado, Snyder, Agawam and Kittitiny.

In closing I would like to call your attention to the still greater possibilities of improving these small fruits and developing new ones. When you consider that the strawberry in this country is scarcely sixty years old, and when you, who can, recall the berries of fifty or even forty years ago and compare them with those of the present day, it is hardly possible to credit the great change. Yet the strawberry of the future will be as superior to that of the present as is the strawberry of to-day superior to that of fifty years ago. Very few of our hybridizers are working on this important group of small fruits. Nearly all of our berries are chance

seedlings, and only serve to remind us what we could do if we only set about it in the same careful way in which the vegetables have been improved. We need more work of this sort done in our experiment stations, in our schools, and, yes, on our farms, for no work is more fascinating than that of creating something new, and we ought all to have some hobby to take us out of the more serious work of life. So those who are interested in growing things might do well to work along some of these lines. I recall a man who, at eighty-eight, is still working on the improvement of the strawberry. This work keeps him young and interested in life, and still he is looking for something better than he has ever produced. Certainly we all enjoy these small fruits, and we ought to have them in abundance. So, in connection with the other fruit development in Massachusetts, let us work to increase the production and consumption of this important group, the small fruits, so that our farmers may profit thereby and our people get the benefit of fresh, clean fruit produced on near-by farms.

Mr. Erwin. The lecturer would be glad to answer any questions upon his subject.

Question. What are the dimensions of the tray for marketing strawberries?

Mr. Wheeler. I haven't the measurements to give you exactly in inches, but it is made to take three baskets the wide way and six the long way. There is room enough so that you can put the berries up an inch or so above the basket and still the tray above will not bruise them. That is one advantage, because when you get to the market you always have your baskets full, whereas with the 32-quart crate you can only fill the baskets level, and there is more or less settling. One advantage of this tray is that the grocer can set it in the window at different angles and it makes a very attractive window package, not only for strawberries but for currants, raspberries and blackberries. It is especially good for the local market. These trays are all returned by the grocer. In actual practice we label them and get them back. They are made of stock about five-eighths of an inch thick and cost about 22 cents each.

QUESTION. How does the price when delivered in that way compare with the ordinarily put up strawberries?

Mr. WHEELER. Last summer the first berries we sent in these trays brought 30 cents; the berries the next week in this tray brought 20, and in crates about 12½. Generally they vary, but in trays it is sometimes double over crates. We generally get 5 or 6 cents a quart more in these trays than in the 32-quart crate. In this package you must be sure that all your berries are No. 1.

QUESTION. In what form do you market currants?

Mr. WHEELER. Generally in the 32-quart crate.

QUESTION. What proportion of sulfur do you use in spraying?

Mr. WHEELER. I use the regular commercial solution of lime and sulfur. In preparing lime and sulfur you use 1 gallon of lime and sulfur to 10 gallons of water for a dormant spray; 1 gallon lime-sulfur to 50 gallons of water for summer spray.

QUESTION. What oil do you use?

Mr. WHEELER. I have used Scalecide and Arlington oil; both are good.

QUESTION. How often do you renew the strawberry beds?

Mr. WHEELER. We only fruit them once in the matted rows; it doesn't pay to weed them out. In hills, we fruit them for three years.

QUESTION. Will it pay to plant on the hill system three years?

Mr. WHEELER. Yes, if you keep the runners off in good shape, because you can then cultivate through the rows and keep the weeds out of them easily.

QUESTION. Do you take any stock in Mr. Kevitt's assertion that you can run the hill system for ten years?

Mr. WHEELER. No, I don't; I don't believe in it. Three years is as long as I have been able to do it, and I wouldn't advise anybody to try it any longer; it isn't profitable.

QUESTION. What do you consider a good gross income from an acre of strawberries?

Mr. WHEELER. Last year some of the growers in Concord realized as high as $500 an acre gross income; some of them

more. That was about a fair average with the Glen Mary; most of our men grow that variety almost exclusively.

Question. How do blackberries compare with strawberries for profits?

Mr. Wheeler. The strawberry is much ahead on account of the greater productiveness.

Question. Did you ever try the narrow or half row?

Mr. Wheeler. Yes. I think that for some varieties it is the very best method. In the wide, matted row there are a great many small, poor berries on the inside of the row unless you do a lot of thinning, and in the half row, where you only allow the finest plants to develop, practically every berry is a good one; and the reason holds good for planting in hills.

Professor Rane. What is your opinion regarding the Fay currant?

Mr. Wheeler. It is the darkest red currant that we have that is really good.

Professor Rane. Where do you class the Cherry currant?

Mr. Wheeler. I think it has been propagated so long that it is losing its vigor. There are a lot of other fruits that are going by in the same way. The Fay is better in the size of the fruit and the size of the crop. It doesn't pay to grow the Cherry. The Wilder is the coming currant. It is a larger bush and the fruit very dark red, such as the market demands. One objection to the Perfection is that it is not a dark red fruit.

Professor Rane. The Wilder strikes me as away ahead of any I have seen. My experience with the Fay is that it hasn't been commercially successful. While excellent for show purposes, as a commercial proposition they would not yield but about one-eighth as large a crop as the Cherry or Wilder. Do you raise the Fay commercially in Concord?

Mr. Wheeler. Not personally. I have planted and compared them, of course, in a small way with other varieties. Mr. Frazer, of New York, who has about 20 acres of currants, and 19 of them Fay, says he is getting an average this year of 12 quarts to the bush. That is on a clay soil

and that may make a difference, as it may be better suited to that variety. Most of our soils here are more or less sandy.

Mr. White. How old are the bushes which yielded 12 quarts per bush?

Mr. Wheeler. I think they were four years old. I wouldn't be certain, but certainly they weren't over five; conditions are such, however, that they can grow currant bushes in New York in a year that will take us two years, as their soil is ideally suited to that sort of bush.

Mr. Abner Towne. How much land, set to strawberries, could a good workman attend to during a season?

Mr. Wheeler. If planted in matted rows and he had a horse to cultivate them an acre would keep him pretty busy.

Mr. Roberts. Speaking of raspberries, did I understand you to say that the Herbert needed no winter protection?

Mr. Wheeler. I have had it out in the worst kind of places for four years, and I have never seen any winter killing here, whereas the Cuthbert, under similar conditions, has winter killed practically two out of three years, and I know that the Herbert in southern Canada, where it originated, has never been killed under their winter conditions, which sometimes register 40° below zero; so it must be very hardy.

Professor Rane. Do you consider the Black Cap profitable?

Mr. Wheeler. Hardly; I don't think there is demand enough for them. I understand there are parts of the west where it is grown profitably. It is very productive and the crop comes in all at once, so that about two pickings are all that are necessary. I think if you could get 10 cents a quart it would pay very well.

Professor Rane. Have you ever seen the market glutted with them?

Mr. Wheeler. No, but I have never seen a time when you could sell more than a few crates.

Professor Rane. That is a fruit I can't understand. I was brought up in Michigan, and we used as many of the Black Caps as the Red, but in New England you can hardly get them.

Mr. WHEELER. You can't give them away sometimes.

Professor RANE. I have had that experience. Now, in New Hampshire they always sold right along with the Cuthbert. In Boston you don't see very many of those berries, and they always sell at a very fair price on the market. It seems to me there is an opportunity to make a profit in the Black Cap, better than in the blackberry, and even better than in the red raspberry, because you can surely get a crop: the prices certainly seem to me to warrant our growing them more than we do.

Mr. WHEELER. I think if you could get 10 cents a quart it wouldn't pay to grow anything else.

A VOICE. I have got 12 and 15 cents.

Mr. WHEELER. For how many?

A VOICE. All I could raise.

Mr. WHEELER. I mean, how many quarts?

A VOICE. I sold 30 or 40 quarts a day.

Mr. WHEELER. I think the Black Cap raspberry is the easiest one to raise, and they make plants very freely and are easy to handle.

QUESTION. Isn't the same thing true of the gooseberry?

Mr. WHEELER. It certainly is. If you can get anything better than 5 cents a pound for gooseberries, as they do in New York, I think it is a very profitable berry to raise.

Mr. G. F. MORSE. Can you tell anything about the black currant? Is there any market?

Mr. WHEELER. There is a small market for them. Every year an English friend of mine buys 100 bushels and sets them out, and he says he has been able to sell all his product to his English friends. So the demand among English people exists, but our people don't want them. The Scotch people are very fond of them, for currant jam.

QUESTION. Are you able to tell us the variety of soil on which Mr. Warren raises his strawberries?

Mr. WHEELER. A heavy black soil.

QUESTION. Is that favorable?

Mr. WHEELER. If it is well drained. As I said in my talk, the lighter soil of Cape Cod is much earlier than our heavy, black soil.

QUESTION. Perhaps the reason is that he changed his strawberry patch to another location?

Mr. WHEELER. Perhaps so, yes.

Mr. FOSTER. Is there a commercially successful raspberry that can grow on hills, so that you can cultivate it in the check-row system?

Mr. WHEELER. Yes, it has been done in places very successfully. It is easier to take care of the raspberry when grown that way than any other way. You can cultivate both ways, and by keeping the suckers off so that they don't run out to the sides, you can do very well. It takes a lot of land, that is the great objection.

Mr. KELLY. Would it be a good plan to plant small fruits in a young apple or cherry orchard?

Mr. WHEELER. I think so, for a few years, anyway, but not for more than four or five years at the most. You must, however, fertilize heavily enough and spray sufficiently to meet the needs of both crops.

Mr. BOWEN. What would you consider a good application of fertilizer and manure when you had currants and raspberries among apple trees on land that had been cultivated before the trees were put in?

Mr. WHEELER. Mr. Marshall in fertilizing his apple trees gives a pound of fertilizing mixture, — bone and high-grade sulfate of potash and slag, — a pound a year for the trees, that is, for trees of one year he gives a pound, and if two years old, two pounds, and for three, three pounds, and so on. And for small-fruit crops he found he could easily put on 20 cords of manure to the acre and supplement that with a fair amount — say 1,000 pounds — of good, mixed fertilizer, like bone, slag and potash. The larger amount of manure you get on the land the better it will be, with the possible exception of raspberries, where an excess of manure might grow soft canes.

QUESTION. I have had those black bugs on the apple trees this last summer. Do I understand you to say that Scalecide for fall, and lime and sulfur for spring, spraying, is right?

Mr. Wheeler. The thing to use for the aphis is tobacco extract of some kind. One that has done good service this summer is called "Black Leaf-40." It is advertised in the papers. The Nicotocide Company of Louisville makes tobacco products splendid for this.

Question. I notice quite a lot of green lice on the apple trees.

Mr. Wheeler. Yes, you will find them green and black and red.

Third Day.

Secretary Ellsworth. It is my pleasure to introduce to you as presiding officer one of our largest market gardeners, a member of the Board of Agriculture from the Essex Agricultural Society, one of the grand old societies of the State. He has taken a great interest in the Board and you always see him where there is work to be done. Mr. Frederick A. Russell of Methuen.

Mr. Frederick A. Russell. It affords me great pleasure to be present and to preside at this meeting. We learned last night that in Framingham a house is finished every thirty-six hours. This means that there are going to be consumers to occupy these houses, and it means that it is up to you and me, fellow farmers, to supply the demands of those consumers, for Framingham is only one out of many rapidly growing cities and towns in our Commonwealth. We have, I believe, a better opportunity for market gardening here in Massachusetts than in any other State in the Union. Our markets are such that we can load our produce onto our own wagons and thus eliminate freight or expressage.

Mr. Chairman, I am very glad, indeed, to have the next speaker with us to-day. Meeting him is almost like meeting an old friend, and I have this morning the pleasure of introducing to you the president of the United States Fruit Growers' Association, Prof. R. L. Watts, of the Pennsylvania State College. Professor Watts.

RECENT ADVANCEMENT IN MARKET GARDENING.

PROF. R. L. WATTS, PENNSYLVANIA STATE COLLEGE, STATE COLLEGE, PA.

It is a great pleasure to meet with the farmers and horticulturists of Massachusetts to discuss questions of mutual interest. Your State has long been recognized as one of the most prominent in the Union for its large number of intelligent growers of garden and orchard products. I have visited your State several times to inspect and study the vegetable-growing interests, and it affords me particular pleasure to say that I have always derived great benefit from such investigations. The intensive market-gardening operations and the greenhouse industry of Boston and vicinity attract attention throughout the country, and are well worth the study of every student of horticulture.

Has there been Advancement?

A question which naturally arises at this time is: Has there been advancement in recent years in the market-gardening operations of the United States? Although the agricultural colleges and experiment stations have not given this industry the attention that many other lines of agriculture have received, I have no hesitation in saying that market gardening has made decided advancement. The results of the operations of men engaged in this line of horticulture indicate most clearly that advancement has been made. The growers of vegetables in most sections are obtaining larger yields than ever before, although there are exceptions in communities where the available supply of manure is materially decreased. There is also no question about the fact that decided advancement has been made in the quality of the vegetables offered for sale. Many examples might be given to indicate the improved quality of vegetables sold in the markets of the

United States. We need not go back more than ten years when rough and ill-shaped tomatoes were offered for sale on most of our markets, while now it is seldom that rough tomatoes are seen in the larger markets of our country. Decided advancement has been made with other vegetables, not only in regard to form or shape but with regard to quality. Growers are exercising much more care in the preparation of their products for market, and so far as sales are concerned this amounts to as much, if not more, than the mere question of quality.

The application of science has enabled our vegetable growers to produce with more certain results. With irrigation, intelligent use of fertilizers and spray materials, better tillage tools and improved seed, growers have been able to produce with more certain results and to materially increase profits in most instances. Thousands of farmers throughout the country are now producing vegetables for commercial purposes. In many instances they are grown in connection with general farm crops, and taken to market along with the weekly supply of butter, eggs and other farm products. The advancement in this particular has been more marked near the larger towns and small cities of the country. In this connection reference should be made to the large number of city boys who have had college training and afterwards engaged in market gardening. Numerous cases could be cited of city-bred college men who are doing remarkably well in the production and distribution of choice vegetables.

Lime increases Yields and makes Production more Certain.

In recent years there has been a marked tendency of our growers to use lime more generally. Vegetable growers have not applied lime so much with its general functions in mind as for specific reasons. Every intelligent grower knows that lime liberates plant food, neutralizes soil acidity, improves the physical character of soils, and has other values of minor importance which are considered by general farmers and often by vegetable growers. In recent years, however, lime has been used by vegetable growers with the idea of obtain-

ing more sanitary conditions in the soil. While this in many instances has been the direct purpose of its application, growers no doubt have profited largely from other values.

The most marked results from the use of lime have been noted in the Norfolk region. Fertilizers are applied in very large amounts in this section, and the practice has brought about a soil condition which in many instances is most favorable to crop production. The Virginia Truck Experiment Station, in co-operation with the United States Department of Agriculture, has been particularly active in studying the functions of lime when applied to the Norfolk trucking soils. These results are reported in Bulletin No. 1, under the name of "Truck Crop Investigations and the Control of Malnutrition Diseases." The soils of Norfolk are of a sandy character and belong to the Norfolk and Portsmouth series. They are naturally unproductive, but respond quickly to fertilizers which are often used at the rate of 3,000 pounds to the acre during the course of a year, and in some instances larger quantities have been applied. Green manurial crops have never been generally used in the Norfolk region, although a natural catch of crab grass, which grows during the latter part of the summer, supplies quite a liberal amount of vegetable matter to the soil. The free use of fertilizers, however, in the Norfolk soils has caused an abnormal acid condition which prevents the proper development of many plants. An excessively acid condition of the soil not only contributes to malnutrition but destroys organic matter. In other words, the investigators at Norfolk have concluded that the soil must not contain a large amount of acidity, but that it must have a large amount of organic matter in order to prevent malnutrition. In the experimental plots of the Virginia Truck Experiment Station, from 3,500 to 6,300 pounds of lime have been required to neutralize the acidity of the soil to a depth of one foot. Vegetable growers in all parts of the country will do well to heed the results of the investigations made at Norfolk. They indicate very clearly that growers should endeavor to maintain the supply of vegetable matter by the proper use of stable manures and green manurial crops, and that in many instances lime can be used at a profit.

In connection with the operations at Norfolk it is interesting to note the practice of our greenhouse growers which is becoming more general. Lime is now used by hundreds of vegetable forcers. They have learned that it is unfavorable to toxic substances in the soil, and this may be of special importance in greenhouse management where there is little time for long rotations. It has been found particularly valuable on silt and clay soils because lime tends to flocculate the finest particles of the soil. After treatment with lime, the soil is more open and porous, more easily penetrated by plant roots, dries quicker at the surface, and provides better conditions for the forcing of vegetables. All soils used in vegetable forcing should receive frequent and liberal applications of lime.

Fertilizers are used very effectively.

There is very little information of a specific character regarding the use of fertilizers for vegetables. Growers everywhere have learned the great value of nitrate of soda when applied as a top-dressing both before and after planting. I believe there is universal agreement that it is better to make small and frequent applications rather than very large applications either before or after planting. This quickly acting fertilizer is often sown broadcast without regard to the presence of plants, whatever they may be. If the foliage is dry when the applications are made, there is little danger of burning the foliage from the contact of the salt. While spotting from the nitrate will occur occasionally, the economy of application more than overbalances any harm which may result. When sown broadcast with a swing of the arm, such as is used in sowing clover seed, the nitrate usually rebounds from the leaves and does not lodge, although lodging will occur with certain crops, such as cabbage and lettuce. No material damage will result from the broadcast method of applying nitrate to cabbage, but it is better to distribute it along the rows for lettuce because the leaves are easily burned by contact with this salt.

While large amounts of potash have been recommended for many of our vegetables, and particularly for tomatoes, there has been a tendency to increase the amount of phos-

phoric acid and decrease the amount of potash. This general tendency should not be the practice of growers in many sections because there are soils that need potash more than phosphoric acid for the proper nutrition of the plants grown. It is important for the growers on different types of soils to communicate with their experiment stations in regard to this matter.

With all that has been said and published regarding the great value of commercial fertilizers for the growing of vegetables, manure continues to be the standby of thousands of gardeners. Near the livery stables of our large cities many growers continue the lavish use of manure; *i.e.,* intensive growers apply 40 tons or more of horse manure to the acre. That excellent crops may be grown without such liberal applications has been demonstrated, and yet it is far from me to criticize any grower for using manure so freely when it may be procured at reasonable prices. In fact, the large profits now realized by intensive growers near Boston and other eastern cities would not be possible without using stable manures most extensively.

Irrigation becoming Popular.

For many years irrigation has been an important factor in the agriculture of western States. It has never played an important part, however, in eastern agriculture, or even horticulture, until a few years ago, when vegetable growers in all of our eastern and central States began to give some attention to this subject. A plan was devised and first introduced in Ohio a few years ago, known as the Skinner System of Irrigation, that has attracted wide attention in all gardening sections, and is now in use to a greater or less extent in every State. The producers in certain important sections, such as Boston, Mass., Irondequoit, N. Y., Cleveland, O., Long Island and other places have seen the advantages of the overhead system, and many have installed it over large areas. It is now not uncommon to find a grower who is prepared to irrigate from 5 to 25 acres. It is unnecessary here to describe the details of the Skinner System of Irrigation, which is now generally known among vegetable producers. The merits of the system are well known, and

the whole matter is no longer regarded from an experimental standpoint. Irrigation is largely a matter of insurance, and makes crop production more certain. When properly handled it insures the germination of seeds, successful transplanting and maximum yields, provided other conditions are favorable.

Irrigation is very widely employed by greenhouse vegetable growers. Probably 75 per cent of the growers of lettuce under glass now employ the Skinner system of watering. It is a great labor-saving device, and when properly managed secures uniform distribution of water.

Irrigation and the use of stable manures in vegetable growing have a very close connection. Although definite experiments have not been made to determine the relation between irrigation and the amount of manure to produce a maximum yield, there is a consensus of opinion that irrigation makes it possible to produce maximum crops with less manure than is possible without irrigation; *i.e.*, it is highly probable that irrigation and the annual application of 25 tons of manure will produce as large average annual yields as 40 tons without irrigation. Yields are probably more frequently reduced by lack of moisture than lack of fertility. This whole problem is of interest to vegetable growers because the supply of city livery stable manure will likely become less and less with the increased use of automobiles; *i.e.*, in the future our great city markets will be supplied by vegetables grown farther and farther away from the city, where operations need not be so intensive and where an abundant supply of water is available.

The Humus Problem.

There is universal agreement among market gardeners that the all-important factor in the annual production of large crops is the maintenance of humus in the soil. Producers near large cities have been able to keep up the supply of vegetable matter by the proper use of stable manures. In more remote districts growers have learned how to use cover crops and manures so successfully that they can maintain fertility and secure large crops without the use of stable manures. There are striking examples of such success in vari-

ous States, and particularly in New Jersey. The Freehold potato growers have managed to produce most excellent crops for many years without the application of stable manures and by following a short system of rotation; *i.e.,* many growers in this section have grown potatoes on the same land year after year, following each year with crimson clover which is plowed down in the spring. In some instances the soil has become so rich in the nitrogen derived from crimson clover that the growers have been forced to abandon the use of this legume and substitute non-legumes, such as rye and wheat. Thousands of truckers in New Jersey depend solely upon cover crops and green manures to maintain the vegetable matter of the soil, thus clearly demonstrating that with good management a profitable line of cropping may be followed without the use of stable manures. Commercial fertilizer, of course, must be used in proper amounts.

Improvement in Varieties.

Gardeners who have had years of experience in producing vegetables, either for the home table or for commercial purposes, agree that there has been a decided advancement in varieties. This statement will hold with nearly all classes of vegetables, although there are exceptions. Perhaps the most marked advancement made in this particular has been among the gardeners themselves in placing reliance upon a few good varieties rather than upon a multiplicity of varieties offered by seedsmen. In this connection mention should be made of the Earliana tomato, which is planted more largely than all other early varieties combined. Stone as a late tomato is unquestionably the leading variety for canning, and is planted almost exclusively for this purpose in many districts. Examples among other classes of vegetables might be named to show that the vegetable growers of our country are pinning their faith to a limited number of varieties, and that new varieties are not largely planted until their real value has been demonstrated. As an illustration of this fact the following table of a variety test of asparagus made at the Pennsylvania State College shows the value of Palmetto, which has been universally regarded by commercial growers

in most sections as the most profitable. The fact is, there has been agreement among our asparagus men that growers are seldom justified in planting anything else but Palmetto. I presume that varieties which will be developed at the Asparagus Experiment Station, Concord, Mass., will soon replace Palmetto and other varieties which have been largely planted for many years. In this connection mention should be made of Reading Giant, which is giving better results in some sections than Palmetto.

	Value of Yield per Acre.		
	1910.	1911.	1912.
Bonvalette Giant,	$72 84	$187 68	$405 72
Connover's Colossal,	64 80	175 68	403 85
Barr Mammoth,	66 24	170 40	394 71
Columbian Mammoth,	47 52	176 64	350 48
Dreer Eclipse,	57 12	174 72	439 43
Palmetto,	63 36	248 64	539 90

Marked Variations in Strains.

It is not enough to know that you are planting a variety which is best adapted to your conditions, but you should know you have the best strain of the variety best adapted to your conditions. The question of strains has been given very little attention by our vegetable growers, and most of them do not know the great differences that exist between strains of the same variety. Experiments conducted with tomatoes and cabbage at the Pennsylvania State College during the past four years show that marked variations exist and should be taken into account by commercial growers. These results have been published in Bulletin No. 119, which will be forwarded upon application by the experiment station, State College, Pa., to gardeners who are interested. In the experiments with Jersey Wakefield (Figs. 1, 2, 3, 4 and 5) the first cutting for 31 strains varied from .22 to 3.84 tons, making a difference of over 3 tons in favor of the best strain. One of the accompanying illustrations (Fig. 3)

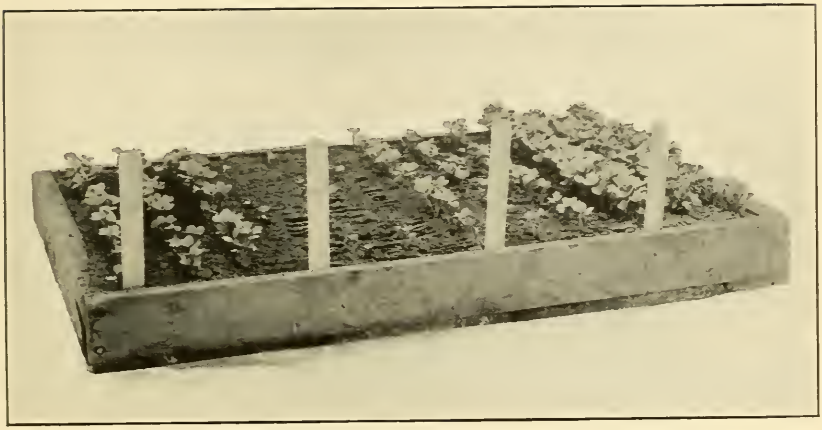


FIG. 1. — Variations in germination of four strains of Jersey Wakefield.

FIG. 2. — A characteristic plant of a worthless type of Jersey Wakefield.

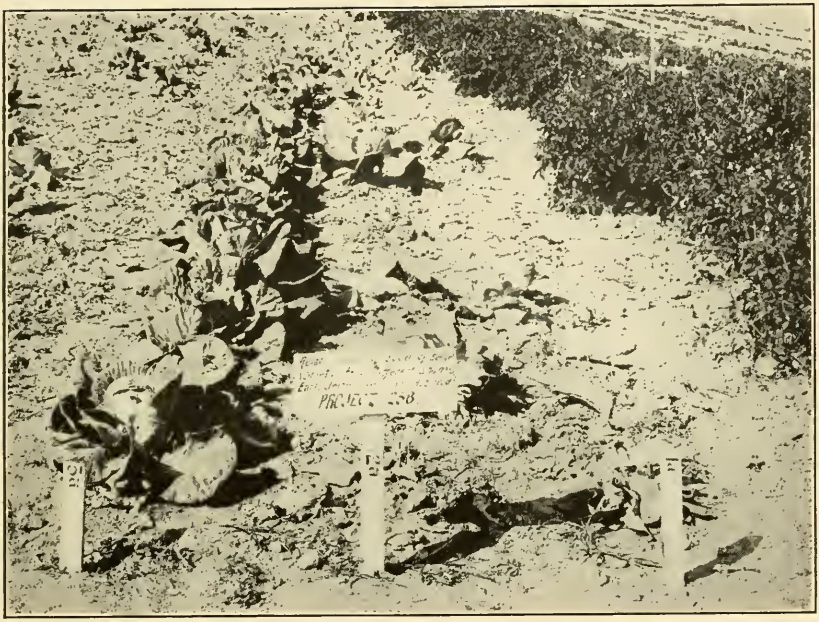


FIG. 3.—Strains of Jersey Wakefield. Note everything has been harvested from rows 1 and 2, while row 3 was very undesirable.

FIG. 4. — Variations in earliness of maturity of four strains of Jersey Wakefield.

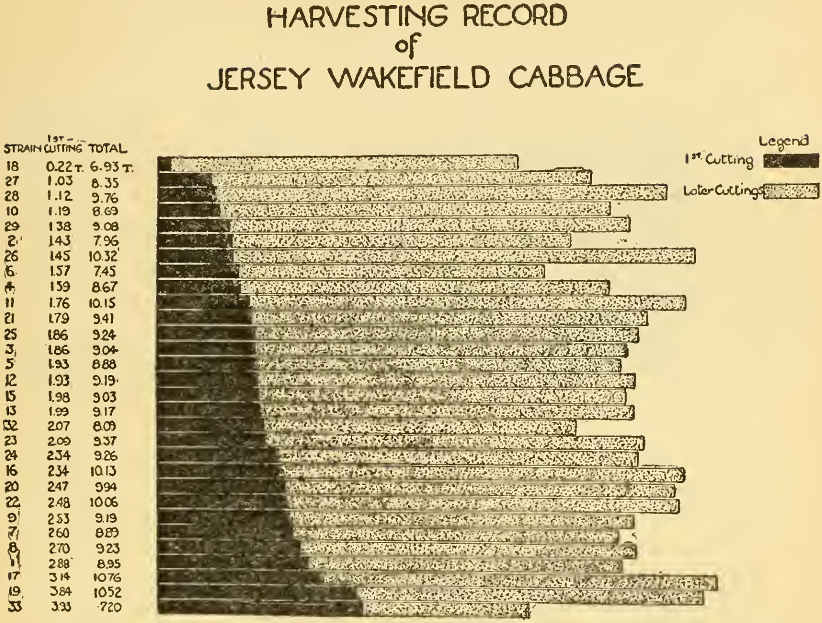


FIG. 5.—Comparative yields of the strains of Jersey Wakefield (average for the test).

shows an almost unbroken row of cabbage which remained in the field when the rows adjoining had been cut and sold at higher prices than prevailed later in the season. In other words, the almost unbroken rows shows a lot of leafy heads, many of which failed to produce marketable heads until the market was broken and prices were materially lower. There was also marked variation in the total yield per acre. In the 31 strains the yield per acre varied from 6.93 to 10.76 tons. The illustrations (Figs. 6 and 7) show that the variation in other strains is even greater than in the case of the Jersey Wakefield. The results of the extensive experiments at State College indicate that greater care should be exercised in the production of good seed. There is no reason why intelligent market gardeners should not produce their own seed, and experiments made at State College and elsewhere indicate that growers using large quantities of seed of certain classes of vegetables will probably in the near future have all their seeds grown by contract for their particular purposes

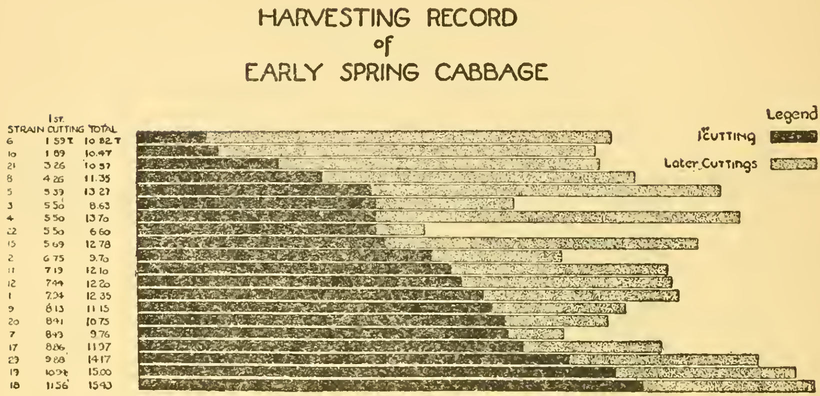


FIG. 6.—Comparative yields of Early Spring Cabbage (average for the test).

and under the management of an expert who understands plant breeding and seed production.

ADVANCEMENT IN MARKETING.

As previously stated, vegetables are now placed on our markets in better condition than ever before. There is need

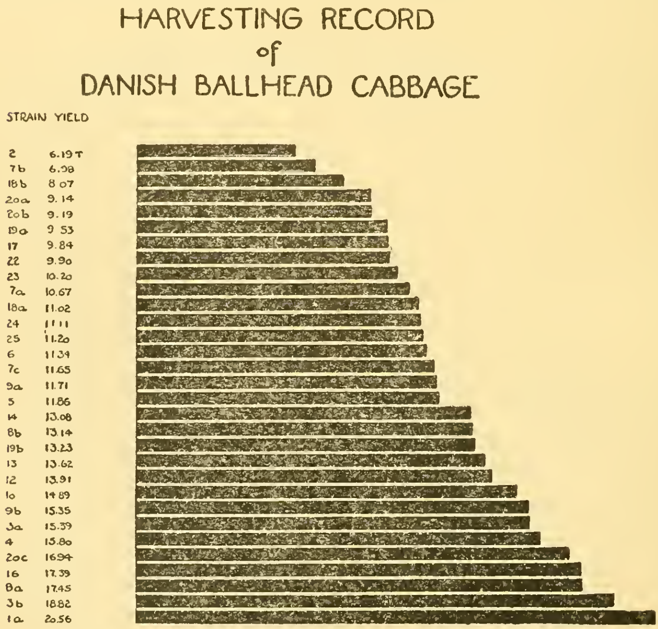


FIG. 7.—Comparative yields of Danish Ballhead (average for the test).

of improvement, however, in methods of packing and preparation for market. The gift package is becoming more generally used, although in some sections, as at Boston, Rochester and Baltimore, bushel boxes are popular, and there seems to be no disposition to change to gift packages.

There is great need of better distribution of vegetables. Just now lettuce is being sold in Boston for 5 to 15 cents a bushel box containing 18 heads, and is retailed at 6 cents a head. The same condition exists in Cleveland and other sections where lettuce is plentiful. While the large city markets are glutted with lettuce, there are hundreds of cities and towns where lettuce is scarce and is commanding high prices. More uniform distribution would relieve the condition in the cities and supply the small towns. I see no reason why parcel post will not ultimately relieve the situation. With the extension of the parcel post system lower rates will probably be granted, and this will make it possible to make shipment direct to consumers who could not otherwise obtain greenhouse lettuce. No doubt lower freight rates will also make it possible to secure more uniform distribution.

It is interesting to note the extent to which auto trucks are being used by vegetable growers. In fact, they are fairly common in some districts. A New Jersey fruit grower and trucker, operating 18 miles from Philadelphia, has replaced eight teams by the use of a 5-horse-power auto truck. This truck makes four trips to the city every twenty-four hours, thus delivering each day 20 tons of produce. The vegetables are first pre-cooled by keeping them for a time in farm storage and then hauled to the city. They are placed on the market in much better condition than is possible by hauling with teams. A Long Island grower who lives 30 miles from the city has had similar experiences in transporting vegetables. It is apparent that vegetables can be hauled long distances to market cheaper by motor power than horse power, and they can also be placed on the market in better and fresher condition than is possible by the use of horses. In this connection, the statement should be made that high prices are usually obtained by growing the very best quality of vegetables and placing them on the market in the most

attractive condition. Appearance counts for more than anything else in obtaining high prices, and too much care cannot be exercised in the cleaning and grading of vegetables and in arranging them artistically in packages which are neat and attractive.

Mr. Erwin. I would like to ask if you can take all-season cabbage and make it head up hard for winter?

Professor Watts. You can never make the all-season cabbage as hard as the late cabbage, but by proper use of the mineral element you can make it harder than you can without.

Mr. Erwin. Can you make it hard late in the fall as you can the late summer cabbage?

Professor Watts. No, I should say not; although early planting will help to do that, but there you run the danger of its maturing too soon and bursting. The trouble is that winter comes on and catches you before all your heads are hardened.

I want to say that we have a bulletin entitled, "Strain Tests of Cabbage," which is just out. I will be glad to mail it to any one. Simply address, State College Agricultural Experiment Station, State College, Pa., and ask for Bulletin No. 119.

I want to call your attention to another experiment. I believe that every experienced asparagus grower in this country realizes that it pays to plant a large one-year root. We have been running a little crop experiment with the Palmetto at the college to show that. The practical conclusion from our results is that a man had better throw away the small roots rather than plant them. Grow your own roots, grow lots of them, and discard all the small ones. We have secured similar results with the Argenteuil.

Question. Does a cover crop that is raised and plowed in for a succession of years, fill all the elements of the soil without much fertilizer?

Professor Watts. The same principle is involved there as in the use of large quantities of manure. The growing of a leguminous cover crop necessarily adds to the supply of

soil nitrogen, so that it is unnecessary to use as much nitrogen in the fertilizer. On the other hand, you do not increase the total amount of mineral element. The cover crop does increase the availability of the mineral supply in the soil, but not to a sufficient extent to make the use of a mineral element in fertilizer unprofitable, so that the universal practice in those communities is to use fertilizer rather freely.

Mr. Wilfrid Wheeler. I would like to ask about the use of sulfur as a fertilizer.

Professor Watts. I am very glad we have with us here to-day one who can answer that question better than I. I will ask Dr. Wheeler to answer it.

Dr. H. J. Wheeler. The Wisconsin State University has recently published a bulletin, by Professor Hart, in which attention is called to the occasional rapid depletion of sulfur in the soil. The fact is brought out that where stable manure is used there will be sulfur enough maintained for all purposes. It has yet to be proved in an experimental way that the addition of sulfur or sulfur compounds will be of any particular importance generally in connection with the growth of plants. It is one of those points that is interesting, and it is well to give it careful consideration. The possible usefulness of sulfur may further explain the remarkable beneficial action of acid phosphate in some instances.

Mr. C. W. Prescott. In the experiment station at Concord we conducted a small experiment with two strains of asparagus. We had two strains which had been considered quite rust-resisting. Five rows of each kind were planted side by side under exactly similar conditions, so far as fertilizer was concerned. That experiment has been carried on for three years now, and every stalk in the rows has been weighed and counted. They have been sorted so that the large stalks, anything that ran 16 inches, were considered giant. Those were cut separately and counted and weighed; and to show you the importance of selecting the strain, even of perhaps the same kind of asparagus, same variety, one strain gave something like eight to 10 times as much giant asparagus as the other. That meant a very large difference in quantity of crops and also in money value. Out of 76 dif-

ferent lots — not all different varieties, but different lots or strains — only two seemed of any value to those in charge of the station. One of those was the Giant Argenteuil, and the other was the Reading Giant, which has been grown lately to a large extent. We are working now on the breeding of a rust-resisting variety, and the results have been quite marked. The Reading Giant has given more pounds per acre and given better satisfaction there and is more rust-resistant than any other kind that we have grown.

Mr. PRESCOTT. Is not the use of potash in the New England States more profitable than the use of phosphoric acid in larger quantities?

Dr. WHEELER. Soluble phosphoric acid is especially needed in connection with the cabbage, turnip and other closely related crops, and they will practically fail for lack of it where millet and certain other plants will grow fairly well.

Mr. RUSSELL. In what form can lime be best used?

Dr. WHEELER. The answer to that question must be different for different soils and different crops. I believe for all the light, sandy and gravelly soils, especially if subject to drought, and particularly for the crops that are not greatly in need of lime, that the carbonate of lime is the best and safest form, because no immediate injury will result from its use. Considering all of the forms of carbonate of lime I should prefer the marl, because I believe it is more immediately effective than those which have a crystalline form, such as the ground limestone and ground marble, yet these are highly effective if finely ground. But on heavy types of soil, such as clay and some of the heavy silt loams, particularly if they contain large amounts of acid vegetable matter, I believe that slaked lime may often be used to advantage. It can be either air-slaked or water-slaked. The slaking may be done by sprinkling two and a quarter pails of water slowly over each cask. In a few hours the lime will be in the shape of a dry powder which you can use in the same way as when air-slaked. In the experiments which I have conducted with alfalfa in every township in Rhode Island, it was found that on those soils which were exceedingly acid, better results

were usually secured with the slaked lime than with ground limestone. If you can apply the ground limestone long enough before the alfalfa is sown it will answer the purpose, but when one must seed early in the spring or early in August, on very acid soil, and must lime immediately before seeding, either the air-slaked or water-slaked lime will be preferable. The same is true of the hairy vetch, which is equally as much in need of lime as alfalfa. For a light, sandy or gravelly soil, from ½ to 2 or even 3 tons of ground limestone per acre should be used. For the heavier soils one may apply 3 or 4 tons of ground limestone. Not more than half a ton to a ton of slaked lime should be used on any of the light soils, whereas on the heavy silt and clay soils, and on those rich in acid vegetable matter (which is immediately removable by ammonia water), one may use from 1½ to as high as 2½ or even 3 tons with great benefit. The amount, of course, depends upon the kind of a crop to be grown.

Question. Will the air-slaked be as good as the water-slaked?

Dr. Wheeler. It is better and safer to use where there is any danger of immediate injury to a crop. One should remember that slaked lime consists of a mixture of water-slaked lime and carbonate of lime, hence it stands between ground limestone and marl on the one hand and water-slaked lime on the other. The longer it has been exposed to the air the more carbonate there is in it, and the safer it is to use on light, sandy soil.

Mr. Russell. Mr. Howard of West Newton is here, a member of the Board. Can we hear from Mr. Howard?

Mr. H. M. Howard. Mr. Chairman and Gentlemen. I was very much pleased with the address we have heard this morning. The work along this line of variety tests and strain tests I think is something we are all experimenting on on our farms right along. I find that celery from some pieces of land will stand up in storage for three and five weeks longer than that from other pieces, and that must be due to some extent to the manure. There must be something in the make-up of that celery that makes it stand up. When the very same seed is used on the whole farm, one section will

produce short, thick celery with a nice, waxy look. On another field the celery will grow long and have no waxy appearance, and this is quite apt to go to pieces very quickly in the pit. These various fields are manured alike, about 25 cords of manure to the acre, and about 200 pounds of nitrate of soda in addition to the manure, and the difference in the make-up of the celery must be due to some property of the soil. Now I didn't know but something might be put onto these other fields which would give the celery in them this waxy appearance and make it grow short instead of long. If I could put in something there for $25 or $50 an acre which would give it that appearance I would do it right off.

Mr. Moore. What is the general condition of the two soils on which you grow this celery; you speak of different fields?

Mr. Howard. The land which grows the waxy celery is a heavy loam and is located at the top of the hill or on the side of the hill. At the foot of the hill we have a heavy sand, about 2 feet deep. Underneath that is a water table, not more than 2½ feet from the surface of the ground. All of the celery that grows on that low land will grow long and slim and never have the waxy appearance which characterizes that grown upon the high land, but the manure in both is just the same.

Mr. Moore. On that very point, where it grows so heavy, I wonder if it isn't the water table, — its getting more moisture. I think we have all observed that with less water it grows a little stockier, and it seems to me that the water takes the force off the celery.

Mr. Howard. I would like to ask the Professor if he has had any experience with beets which would lead him to think that you can develop a strain of beets coming off about two weeks after you begin to pull the first ones?

Professor Watts. We have not conducted any experiments with beets at the State College. I should think, though, that you could materially shorten the time of production by selection. I don't know just to what extent you could accomplish that, but I am quite certain you could make progress.

Mr. HOWARD. On some 20 acres we used to think it was necessary when we started in business to clean off all the beets by the 7th or 8th of July, and we usually got them all off; but now we do not. We start pulling about the 16th and 17th of June, and now a good many times we don't clean them all off before the 25th of July or 1st of August.

Mr. RUSSELL. Do you thin them as heavily as you used to?

Mr. HOWARD. We thin them as thin on the early planting, but the late planting we let stand a good deal thicker than we used to. The early planting we let stand 5 or 6 inches apart, and the late planting 2½.

Secretary ELLSWORTH. I move that the Board extend a vote of thanks to the Middlesex South Agricultural Society for providing the hall and for the manner in which they have entertained us. I feel very much flattered with the reception that has been given here by all the people, as well as by the Framingham Board of Trade.

Carried unanimously. Meeting adjourned.

SUMMER FIELD MEETING

OF THE

STATE BOARD OF AGRICULTURE

AT

LOWELL.

JUNE 21, 1912.

SUMMER FIELD MEETING.

The summer field meeting of the Board was held on the C. I. Hood farm, at Lowell, on June 21. The weather was ideal and the total attendance for the day was estimated at about 1,000. The program was an especially good one. It was opened by a demonstration and talk on tools and machines used by the market gardener, by Henry M. Howard. This was followed by a demonstration of a gasoline traction engine and gang plow by a representative of the International Harvester Company. Evan F. Richardson then gave an address on harvesting and curing hay, and a demonstration and field trial of haying tools and machinery. In the afternoon Prof. Chas. S. Plumb gave illustrated talks on the points of the dairy cow and the hog, judging animals in each case with the use of the score card. The scene of operations was then shifted to the Geo. W. Trull farm, where an excellent demonstration of the use of dynamite in agriculture and its practical application to the various operations of the farm was given.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE

PUBLISHED IN

MASSACHUSETTS CROP REPORTS, 1912.

PORK MAKING FOR MASSACHUSETTS FARMERS.[1]

A long-neglected industry promises rich returns under modern methods.

DR. GEO. M. TWITCHELL, AUBURN, ME.

Among all the specific lines of farm work, whether cropping or breeding, none is more stable or certain to return a generous per cent, year by year, upon the outlay, than pork making, yet throughout Massachusetts no branch of agriculture is so much neglected. Here and there single individuals, or corporations, have engaged in the business, but all the while we face the fact that the State does not produce pork products sufficient yearly for one week's supply for its own inhabitants.

What is true in Massachusetts holds throughout New England. All the while men are running here and there searching after some avenue into which energies may be directed and success insured.

We have passed out of the era of low prices for any meat product, and with our steadily increasing population there is no prospect of any permanent reduction below present standards. For these reasons it is perfectly safe to figure the industry upon the prices of 1911 and be certain that fluctuations will insure just as good an average, and probably better. With these fundamental facts recognized, surprise increases as one contemplates, on the one hand, the possible sure returns, and the almost total lack of recognition of the same by the rural inhabitant, on the other.

Modern Methods a Necessity.

The greatest stumbling block in the pathway of the average man who contemplates the possibilities of pork production is the old-fashioned pigsty. Habit is so exacting that its full force can hardly be imagined. The pigpen must go, before pork making can become either a lucrative or even an attractive industry. It is one of the relics of olden times to which New England clings tenaciously. Pork may easily be made the cleanest, sweetest and most healthful of all the meat products. Naturally the hog is one of the neatest of

[1] Crop Report for May, 1912.

animals, so that in judging the industry it must be from the viewpoint of the man who conforms to the demands and conditions of to-day.

Economic pork production hinges upon the utilization of forage crops, the pasturing of the herd and the cutting out of all purchased grain. The problem is, can this be made effective in actual practice as in the west? Here is the crux of the whole situation. Fortunately, we have the experience of a number sufficient to maintain the claim.

Methods of utilizing Forage Crops.

One acre in forage crops will provide all the food wanted by eight well-grown brood sows, and one-half acre in rutabaga turnips and mangels will supply the bulk of food for winter, until we approach farrowing time. Add to this clover hay and a minimum amount of grain and we have an ideal winter ration. How much grain will be demanded cannot be stated in pounds or bushels because of the individuality of the animals and difference in digestive and assimilative capacity. This grain should be corn chiefly, and experience will determine the amount required to supplement the roots and clover, the purpose being to keep each brood sow in healthy, growing condition. While good results will follow the pasturing of a herd on an acre sown to rape, clover and barley, at the rate of 3 pounds of dwarf Essex rape, 7 pounds of red clover and 1 bushel of barley, I am convinced that the plan outlined by Commissioner Huson of New York, and practiced yearly by him, is more economical and will insure better results.

The first is the plan followed at Elmwood farm, when I was in charge there, and which gave surprising returns. Mr. Huson divides this acre into three or four paddocks, with movable hurdles thirty inches high. In September he sows rye in one and turns onto that in early spring, where the shoats thrive wonderfully. By the time it is gone over, but not eaten too close, the paddock of rape, sown in early spring, as soon as the ground is warm, is ready. Then follows one of clover and then one of oats and peas. By the time these have been fairly eaten down the rye will have come again and matured a fair crop of grain, every kernel of which will be utilized. Naturally, the process of change from one paddock to another will be modified by the conditions, the best results obtaining when excessive growth is checked by changing from one to another and each one watched to see that it is not eaten too close. Of course the amount of ground demanded will be determined by the number of hogs kept, but this process of supplying the most healthful and cheapest food possible is so simple that it must commend itself to every would-be pork maker. March pigs grown in this way should be ready for market in October, requiring only enough

grain to be carried along steadily, and finally finished in short order for the early market. For this finishing, corn and pumpkins, grown alongside the paddocks, constitute the best and most economical food to be obtained, reducing cost of production and labor of feeding to the lowest dollar, while insuring a quality of product impossible to mature in close pens or with swill-fed animals. The whole problem of profitable pig production hinges on one's ability to minimize cost, both of labor and purchased grain, and, at the same time, feed to insure steady growth. For this reason the growing of the finishing crops alongside the summer pasture must commend itself to every business pig grower. The first step is to grow a strong, bony frame, with abundance of flesh and muscle. This insured, the cost of finishing may be reduced by restricting the range, care being taken at all times to keep everything clean and make certain a bountiful supply of fresh water. We not only want fat, but it must be hardened for market. The inexpensiveness of a crop of pumpkins, and their value in promoting growth, as well as their general tonic effect, make them an ideal food to combine with corn. If the pumpkins and corn are grown alongside the pasture, the whole expense of handling and feeding is minimized, the labor item being confined to cutting and throwing over the fence. To turn the drove into this field might save labor, but the loss from corn and pumpkins trampled upon and wasted would be heavy. If by any other combination of rations the same rapid fattening can be insured at less expense, then surely it should be followed, the whole problem being to obtain most rapid growth towards the market at the least expense. Two possible dangers to be avoided are those of not feeding at regular hours or the attempt to save in quantity. Either will prove suicidal. Instead, the effort should be to so feed as to encourage the largest consumption consistent with health. No arbitrary rules can be given, as much depends upon the eye and hand of the feeder.

There is good evidence in support of the claim that one has but to establish himself in this industry, by some such plan as here outlined, freeing his stock entirely from the old-time methods of pigsty or barn-cellar growing, and advertising a healthy product made only on forage crops, in open pastures with home-grown grain, in order to insure a permanent market at advanced prices. The absolute purity and cleanliness of the product, and freedom from all possible taint of impure surroundings and stale swill feed, will attract buyers. It will be understood here as everywhere that an abundance of fresh water *must* be available at all times, and if possible it is best to equip a field in close proximity to a brook or within easy access to a water supply. In this way the labor item during the growing season is practically eliminated. The best cure for disease is prevention, and that will practically be insured by the plan here

outlined. Disease lurks in filth or is carried in decayed food. Fresh air, sunshine and pure water are germ destroyers. But behind the problem of feeding lie some important factors, not one of which can be overlooked.

Type and Breed.

Too many start with or breed from immature sows. The hog of to-day bears but a slight resemblance to its early ancestors. The process of elimination and intensification of traits, form, growth, etc., coupled with the law of environment, has resulted in a creature radically different from the long-nosed rooter of years ago or the razorback of the south. To be a successful breeder one must enter fully into an appreciation of the changes resulting in what we see to-day, and be prepared to push the wall of opposing forces still further into the background. So tenacious is the law of reversion that there is demanded a firm grip and steady hand to insure improvement. The question of breeds is here as elsewhere secondary to type. The pork maker wants a pig which, given right conditions, will make from 175 to 225 pounds of dressed product in six months. First of all, we want the long-bodied, deep barreled, strongly built sow, with a broad, intelligent face, a docile, quiet disposition, the ability to consume a large quantity of food and certainly to supply an abundance of milk for a litter of generous dimensions. Breeding White Chesters I found that some sows would produce 12 or more, at every litter, while own sisters brought but 7 or 8; also that these large producers would give 2 or 3 pigs or more, which, at four weeks, would weigh 25 pounds, with the balance following closely, while the best I could do with others was 18 or 19 pounds.

It takes a trial trip to gain this information, but a man has himself to blame if he gets a second dose. Blood alone does not insure type desired, though strains of each of the breeds have this well established. Here is where experience is the best teacher. Naturally, enthusiasm will center about the breed which pleases the eye, be it black or white, but pork makers to be profitable must never lose sight of the standard of utility which must always center in type adapted to purpose. Looking for special results, a specialized animal is demanded, one bred and built for rapid pork making. Brood sows which are worth using as mothers are worth keeping so long as they will produce. It is ruinous policy to change yearly. Keep a sow as long as she is rugged and productive. Surely no one can justify the use of a grade boar while he may succeed well with grade sows. In a boar look first of all to the character, type, production and disposition of his ancestors on both sides. Finding these to be satisfactory, what of the animal himself? Is he strong on his legs, compact rather than long in body, massive in shoulders, with good hams, and, above all, does he possess the

shape and character of head wanted in the profitable meat maker? Did he come from a dam noted for large litters of strong, healthy pigs? After making the selection test him, and, if satisfactory, keep him as long as he is of service. Beyond that when the time comes to change be sure and get another of the same breed and still better in every essential. The trials, troubles and disappointments of would-be pork growers may very largely be traced to the use of immature sows or boars, or an almost total neglect of the laws of breeding in making selection. The single fact that one, or the other, is a Chester, Berkshire, Poland China or Yorkshire proves very little, simply for the reason that so many who breed what they term pure-bred stock, either fail to register same or neglect the essential principle of worth and cling to blood alone. On this rock thousands have gone down who aspired to be known as breeders. There is a blood inheritance, which, backed by individual merit is of transcendent value, and this alone will satisfy or recompense the breeder. No man looking for the dollars through cheap pork production can afford to mix breeds. Price in a boar bears slight relation to value as a sire. Important as is breeding it must always be backed by good feeding, health and vigor being the goal one is seeking.

Care at Farrowing Time.

The evils and troubles of pork raising can, in the great majority of cases, be traced directly to want of proper food or care. Especially is this true at farrowing time. If, in every pen where brood sows are kept, there is a small box constantly supplied with 1 bushel of charcoal, ½ bushel of ashes, 1 peck of salt and 4 pounds of sulphur, mixed together, there will be little danger of trouble at this critical period.

Sows eat their pigs because of an unsatisfied craving, the result of unbalanced and improper rations. When the time comes to separate the brood sows and place them in pens, with guardrails all around, the time has also come to change the feed, and from now on middlings should form the bulk given, with some vegetables to keep the bowels in good condition. Not until close to farrowing should excess of sloppy food be given. If the sow has been handled gently all along she looks upon her care-taker as a friend. Not a day should pass without a visit to the pens and a few moments devoted to scratching her back. Then, when the little pigs come, she will not be disturbed by your presence, and many accidents will be avoided. It is these seemingly trivial steps which tell mightily in profitable pork production.

If a litter of pigs is farrowed early in March, the sows should be ready to breed in September, though some wait one year, believing that they will be more productive and the offspring larger.

Very much depends upon how the pigs are reared. If kept growing from the first, and in good condition, not fat, they will be ready to take up the duties of pig bearing so as to bring their first litter at twelve to thirteen months of age. No rigid rule can be laid down, so much depending upon the owner. No sow should be kept for breeding unless she be growthy, healthy, vigorous and full of life, with body of good length and depth. Never use a weakling or one that has halted in the least during the period of growth. The rule is that nature is lavish in providing teats for a large family, and surely no wide-awake breeder would use a sow deficient in this respect. Many are the little details a breeder must have in mind if he is to succeed, and not one can be neglected.

Care of Pigs.

In every pen there should be a slatted partition arranged, to be lifted up and dropped easily. After the pigs have had their breakfast, lift this and drive them under, then drop in place. They are with their mother, yet separate from her, and the exercise sure to follow an attempt to get with her will do much to ward off disease and promote vigor and strength. Repeat this again in the afternoon, but surely allow the family to be together overnight.

Before two weeks old a small trough should be provided, into which pour a little fresh milk at frequent hours, being careful to thoroughly cleanse each time before filling. Gradually a little middlings may be added, and when the time comes for weaning, the process is simple and there will be no loss. Instead of taking the pigs away from the sow, when six to eight weeks old, remove the sow from the pigs and they will hardly miss her, because they are in the only house they have ever known. It means a big, big loss to put a litter of pigs in strange quarters and have them squeal and starve for a couple of days, when a little thought would save all this. Look well to the teeth of the little fellows, but don't hunt for black ones as the cause of all earthly ills. If any are over sharp and are lacerating the cheek snip off the top with a pair of sharp pincers.

A healthy sow can well produce two litters a year though there is not as much profit in the second as the spring litter, but a little attention should be given to time of their coming. It is well, if the quarters are warm, to have the early litter come the very first of March and then breed the sow again five days after removing her from the pigs. This would allow for them to run with her six to eight weeks, and have the second litter come the last of August.

Success Dependent on Type of Man.

There is no chance for a shiftless man to win success in this business, for the details, while not burdensome, are exacting and will not permit of neglect. No man should attempt to keep hogs who does not visit his paddocks or pens daily, who cannot find the right side of a hog and be on friendly terms with every one, and who does not see in the business full scope for all the skill, thought and application at his command. It is a good business for any live man, but one not to be neglected. The measure of profit will depend upon the energy and watchfulness as well as appreciation of the master. From a purely business standpoint pork production may well be urged upon Massachusetts farmers, for, scattered all over the State, there are skilled breeders, of all representative breeds, and full advantage can easily be taken of all expense, study and experience expended by these specialists in building up their strains.

Especially should this business appeal to the man of moderate means, for it is not a difficult proposition for one ton of pork to be produced from the offspring of a single sow in one season, and surely, following the hints here given for production of home-grown food, it comes pretty near a case where a man has his cake and eats it also, for he has his brood sow left for further production, his farm is being improved, and a substantial sum is yearly being added to his net income. Rightly fed and properly treated there is no animal so free from disease as the hog.

Prevention of Disease.

If by any cause disease gets a foothold, radical measures should be resorted to at once to prevent a spread, and to cure the sick. Isolation is the first step to be insisted upon, and that in dry, clean, well-ventilated pens. Then will come the specific treatment given in the bulletins published by the government. Recognizing fully the importance of prompt and thorough measures, it is yet necessary to emphasize again and again the supreme value of prevention of disease by a proper recognition of sanitary and hygienic conditions, and the use of nature's best food products in the making of choice, fresh, delicious pork.

Cost of Production.

Growing the roots, forage crops and corn for finishing, pigs can be grown to six months and to dress from 175 to 225 pounds for 4 cents per pound. We must remember that the rapidly grown young pig gives the best net returns, that it costs much more to gain a pound after six months old than at four, and that the secret

of success lies in rapid growth, generous feeding at finishing and an early visit to the block and the pork barrel.

If it were possible to stimulate pork production along economic business lines, so as to supply the home markets of the State, a new life would be injected into every department of agricultural work, and an era of rural prosperity be ushered in such as was never before witnessed. The market is at our doors here in New England; the demand is active; the army of nonproducers increases steadily. There is no possibility for lower prices to be maintained, and this field, open before the energetic home builder, is attractive, permanent and sure to be remunerative in an increasing ratio as the days go by.

IRRIGATION IN MASSACHUSETTS—METHODS, COST, RESULTS.[1]

BY MR. HENRY M. HOWARD, OF WEST NEWTON, MASS.

In order to plow a straight furrow it is absolutely essential for the plowman to keep his eye on a certain point toward which he is working. So, in studying the irrigation problem, it is just as essential that we see clear through to the results which we are aiming for, and that we never lose sight of them. These results are larger crops of better quality.

By using good judgment and proper methods a man can supplement a scant rainfall so as to attain these results to a very large degree. If the farmer has already made all other conditions favorable to crop development, save that very important one of moisture, it is surely up to him to make that condition correct as well.

Without water no plant or animal life can grow and develop. Water is indispensable to all life. Water is a food and also carries food. All food for plants or animals must be in solution before it can be assimilated by them. Another fundamental use of water is its property of cooling the surface of plants and animals as it evaporates from them. Both of these uses of water find their fullest application in irrigation operations.

Water falling as rain or snow is in the best possible form for the earth to receive it. It falls slowly and works its way down into the subsoil from which it will be drawn again by the sun and by capillary action.

The amount of water a soil will hold depends upon two things; first on the size of the soil particles and second on the amount of humus in the soil. The soil water which is available to the plant is that which is clinging to each soil particle. The finer these particles, the greater is the capacity of the soil to hold water. Gravels and sandy soils have larger soil particles than the loams and clays. Soils which are full of manure contain large quantities of humus which will hold a great store of moisture.

Cultivation and hoeing preserve the soil moisture. Horse cultivation to preserve moisture should be not over 2 inches deep, and as

[1] Crop Report for June, 1912.

often as once in five to seven days. This 2 inches of soil mulch has its particles so separated that capillary action is prevented and the moisture is kept stored down where the root system can make use of it. Cultivation and hoeing, to be most beneficial, must be done often so that the soil mulch will be kept dry, and are just as essential in a wet season to prevent disease as they are in a dry one to promote growth. In a wet season poor cultivation allows the root system to develop near the surface, and then when a dry spell comes and cultivation is begun, so many roots are destroyed that development is arrested and disease invited.

The roots of plants go down 4 feet or more and extend laterally in all directions. Coming in contact with soil water they take it up with all it contains and carry it to the leaves where digestion and growth take place. When we apply water to a crop we want to get that water down. We are aware that very often little summer showers add no water to the available moisture in the soil, for they do not get down below the soil mulch where the root system is at work. We know that the shower does cool the surface of the plants and improves the climatic condition. When we apply a small amount of water with a hose we are more likely to injure than to improve the crop, because the soil mulch is spoiled. Firming or rolling the surface of land, after seeding, is done to promote better capillary action and bring up water enough to germinate the seed. As soon as the crop is up cultivation begins and we aim to produce the soil mulch and preserve the soil moisture.

The foregoing remarks in regard to the uses and movement of water in the soil are made so that all may know and understand the reasons for our ordinary farm practice, and so that those who do not irrigate may be encouraged to cultivate even more diligently than they do at present.

On many farms there is a good supply of water. A brook may be turned aside from its course, and by means of large and small ditches made to irrigate quite large areas. A canal may draw water from some river or pond and be made to serve the same purpose. The cost for dams, canals and ditches is small compared with the value of the results obtained. The writer has in mind several farms where acres of grass land are thus watered, and where the water certainly increased the crop of hay 2 tons per acre, and made the rowen crop profitable.

Flooding the land is practiced on hundreds of acres of sugar beets and pasture lands about Salt Lake City, Utah. The water comes down from the mountains in great flumes and is used to flood the lands for days at a time. The dairy farmer of Massachusetts who can irrigate his mowing by any such easy methods should certainly do so. The cost of dams, ditches and maintenance on one of the farms above mentioned, where over 7 acres were irrigated, was less

than $100 for a period of ten years, or about $1.43 per acre per year. The increase of the crop due to irrigation was estimated to be 2 tons per acre per year. With such cost and results as these the use of water for irrigating mowings becomes a very attractive proposition. The general farmer will probably never irrigate much. It is for the market gardener a continual study and practice: he must irrigate more or less every year, and needs to be well equipped to do it economically.

There are three principal methods employed: running in furrows between rows of crops; spraying on the surface from a hose; and spraying on the surface by means of some other mechanical device.

The first method is used on crops like corn, beans, tomatoes, cucumbers and squash, but would not do for lettuce, spinach or radishes. The soil adapted to furrow irrigation must be one which does not absorb too much water, as a large stream would soon disappear in sand or gravel. A loamy soil with a moderate slope would be adapted to furrow irrigation. Water for this style of irrigation would need to be very cheap, as it is not spread over enough surface to be most efficient.

The second method, of spraying with a hose, has this great advantage, that the largest amount of water can easily be applied where needed most. There are variations in the soil and drainage in many fields, and the man who applies water from a hose can put the water where it is needed. The cost of putting on water by this method should never exceed 10 cents per 1,000 gallons above the first cost of the water. The usual cost of applying will be found to be much more rather than less because of poor service, poor piping or defective valves or hose. This cost of applying water has set men to figuring on mechanical labor-saving devices, several of which have been invented and experimented with.

This brings us to the third method of irrigating, namely, the use of mechanical devices, stationary, semi-stationary and whirling. The whirling deliver the water in circles, as is also done by the stationary, and each of these have to be moved often to do good work. In general, the smaller the stream from these devices, and the longer continued the application, the better will be the results. The water being applied over a long period results in a more thorough wetting and a more favorable climatic condition, and the fine spray will not injure the foliage.

The semi-stationary type of irrigation is well illustrated by what is known as the Skinner system. By this system water is delivered in very fine streams, 1/32 of an inch in diameter, and with a pressure of 50 pounds will be carried 28 to 30 feet from the nozzle, and will be well spread by the currents of air.

The water used for irrigation on most market garden farms is obtained from the town or city supply, and is the service to be

recommended where it can be secured. The pressure and supply are constant and can be relied on at any time. However, where there is a large area to be irrigated one will always find a private pumping plant in operation.

In laying pipe for irrigation use common black pipe for mains. Lay it on the surface of the ground along head lands or roadways. Have flange unions at convenient intervals and tees with valves every 55 or 60 feet for taking off laterals. Use good gate valves, and avoid short, sharp turns in the mains by using long bends. Where hose irrigation is to be practiced the laterals should be of $1\frac{1}{4}$-inch pipe, and hose connection valves set at such intervals as to make it possible to cover the whole space between valves with a 50-foot hose. A path 2 feet wide should be left at the side of each lateral in which to run and coil the hose. A little advantage will be obtained by running the laterals east and west because the prevailing winds in summer are southerly.

When about to irrigate have the hose in a coil, attach the female end to the valve, and roll out 8 paces. Then turn and roll back to valve, thus avoiding a twist in the hose. Have a soft end or a nozzle for the hose so as to spread the water. With the nozzle in one hand, open the valve with the other hand; water all one side of the path going out, and all the other side coming back. In moving from valve to valve either coil and carry the hose or drag it. With care very little damage need be done. When through the hose should be coiled and put in the shade. Valves should be set up tight but not too hard. If necessary screw in a plug rather than set the stem of the gate too hard.

The cost of fitting up 1 acre for hose irrigation would not be far from $65, and the cost for each additional acre about $50. After having fitted up one-third of the total area you wish to irrigate, the other two-thirds can be cared for by moving the piping until such time as you wish to invest money in more pipe and fittings.

The cost of installing the Skinner system of irrigation will be just about the same per acre. This system seems to be becoming more and more popular over the whole country and, with the improvements being made from time to time, seems to leave little to be desired in the economical distribution of water. The laterals for this system should be of galvanized pipe tapped every 4 feet for a nozzle. The size of pipe for a lateral of 250 feet should be: for the first 150 feet, 1 inch; for the last 100 feet, ¾ inch. These laterals should be 50 to 56 feet apart and run east and west. They are connected with the mains by a special union fitting with a strainer, so as to remove all dirt and scale from the water and enable the operator to set the nozzle line to throw the water at any angle desired. The outlet of each nozzle is $\frac{1}{32}$ inch in diameter. The currents of air break up these small streams so that most of the

water reaches the soil as a very fine mist. By using this system of irrigation water may easily be applied all night, and in a period of eight and a half hours an inch of water be evenly distributed over an acre. It takes 27,152 gallons of water to cover an acre 1 inch deep, and this is usually enough water to apply at one time. If put on with a 1¼-inch hose it would take a man a little over five and a half hours to cover the acre.

There is seldom a year that it is not necessary to irrigate some. An application of 1 inch a week during the three summer months to almost any crop would usually prove very profitable. At 30 cents per 1,000 gallons, the cost would be a little over $8 for each application. If one has his own water supply and good economical engine and pump he can apply an acre-inch for less than $2. (An acre-inch is the number of gallons required to cover an acre of land 1 inch deep.) An outfit to be economical must be in good running order and possess a high per cent of efficiency; that is, if the pump is rated to deliver 90 gallons per minute it should come very close to doing so.

Water should be applied to the soil before plants show any suffering for want of it. The best time of day to apply water is between 6 o'clock P.M. and 6 o'clock A.M., as there is then less evaporation, and more water gets down to the subsoil where the roots can get it. The next best time to apply water is on a drizzly or lowery day. It is better not to water during a showery day. If a crop is being injured by a very burning wind it is time to get busy, and spray on enough water to prevent further injury. Good cultivation must be combined with irrigation to make the latter pay.

Too much water may easily injure crops early and late in the season, but in midsummer there is very little danger of giving too much water. In regard to buying an equipment: purchase pipe, hose and fittings of some good wholesale house, and get enough piping tools to instal the equipment yourself. Get all nozzles and fittings for the Skinner system from the only company that makes them, at Troy, O.

In summing up it may be said that irrigation vastly improves the quality and quantity of crops, increases the profits, and gives the satisfaction that comes from growing the best and biggest crops.

SILOS AND SILAGE.[1]

H. O. DANIELS, MILLBROOK FARM, MIDDLETOWN, CONN.

At this writing we are passing through another long siege of drought, the fourth successive one of recent years, and those of us who are making dairying our life work have more cause than ever to be thankful for adopting the silo. We can no longer ask the question, is the silo a good thing, or, can I afford to build one? Rather, the problem resolves itself into the query, how can I feed a herd of dairy cows, make milk summer and winter, and produce the most silage for feeding them, for it has become almost absolutely necessary to have a supply of ensilage ready for feeding in the summer as well as in the winter.

We have studied this ensilage question here at Millbrook Farm for a number of years, being almost pioneers in the matter of feeding ensilage in Middlesex County [Connecticut], as I believe there were no other silos in use when we constructed our first one nearly twenty years ago, except one at the Connecticut Hospital for the Insane; therefore, possibly in the light of these many years of use, we are in a position to say a good word to our struggling dairymen on the value of the silo. First of all, let me say if you are keeping eight or ten cows and have not a silo do not hesitate longer to build. I think after one year's use it will be found to be the best investment of time and money that could be made. Then, after filling the silo the first year, which undoubtedly will be with corn, as corn is acknowledged by all as the king of forage crops, study a systematic plan for producing silage to feed all the year.

When we began to grow silage crops, corn was the only regularly known plant for this product, and we planted acre after acre of our tillable land to this crop, adding more silos, as the needs of our herd demanded, until we had every available acre of our farm that corn would grow upon successfully in this crop, and still we could not supply enough food for the rapid increase of our herd. Then we were obliged to grow corn after corn continuously, until we were shown a better way by adopting a crop rotation. Our farm is small, relatively speaking, according to the number of cattle we

[1] Crop Report for July, 1912.

are keeping, there being only 72 acres that are tillable, while out of these 72 acres only about half is adapted for corn growing, the balance being meadows which are kept permanently in grass.

We found that by rotating our fields with crops of corn, oats and clover, and clover we could get results in crop production far in excess of a continuous cropping of corn alone. We are able to prove that 36 acres, divided into three sections, each section producing corn one year, oats and clover the next year and remaining in clover the third year, and then back to corn again, will produce more tons of silage in these three years than we ever grew in the same length of time where corn was the continuous crop. In this manner we secure one 12-acre crop of corn, one of oats and clover, and one of clover each year.

In this system it is possible to produce 8 to 10 tons of clover and oat silage as a first crop, with a chance for a good second crop of clover rowen or ensilage the same year, and in the year following 8 to 10 tons of clover silage per acre as a first crop, and also a good second crop for silage or rowen hay.

To bring this matter down to the latest experiences we find the best results are gained by planting corn on the clover sod in the spring following the second year's growth of clover, using 15 to 20 loads of stable manure per acre; then follow the next year with oats, 1½ to 2 bushels drilled per acre, with 8 quarts of clover seed, mixing 5 or 6 quarts of red clover and 2 or 3 quarts of alsike and 3 quarts of timothy, sowing these after the oats, and lightly harrowing in and rolling, sowing ½ ton of burnt lime or 1 ton of raw lime-stone per acre, and harrowing thoroughly into the soil before sowing the oats or clover seed.

The following fall or winter season, or early in the following spring, top-dress this clover with 10 loads of stable manure, and grow a maximum crop of clover silage. In harvesting these silage crops we cut the clover with a mower, load with a hay loader on our flat platform wagons and haul to the cutter, throwing off on to a table or platform on a level with the top of the cutter, and cut all into half-inch lengths and pack in the silo.

After this clover crop, which is part timothy, is stored away in the silo. for the first three or four weeks the silage will come out hot, and we spray water on the same while filling the silage trucks before feeding the cows; but after three or four weeks the silage becomes cured, and a sweeter, more palatable food can hardly be furnished, and nothing will be more relished by the dairy cow. Personally we feel that even if we could grow corn enough to supply our herd all the year we would prefer to fill and feed clover silage during the months of June, July and August. Other good summer silage feeds are alfalfa, with a mixture of orchard grass, or timothy, or the crop of oats and clover grown together.

After the crop-rotation system is well established we find we have enough silage with the second year's growth of clover, and we put the oats and clover of the first year into the hay mow.

Dr. Jenkins of the Connecticut [New Haven] Experiment Station has analyzed this summer silage, and reports it about three times as rich in protein when made of oats and clover, and four or five times when made of clover alone, as the corn silage, and feeding results in producing milk prove these facts. Professor Esten of the Connecticut Agricultural College reports the composition of clover silage as almost identical to the composition of milk, or, in other words, a ration of clover silage is almost perfect for the production of milk.

With these facts in mind, and with an experience of some years' feeding of both corn and clover silage, need I say more to recommend the adoption of this filling of the silos with corn in the fall season for winter and spring feeding, and again in summer with clover for the necessary summer feeding?

A practical experience of clover silage feeding on our farm would place the value of clover silage at one and a half times the value of corn silage, and when these crops of 8 to 10 tons of clover and timothy and 20 to 25 tons of corn silage can be produced per acre, why hesitate longer about building that silo?

We have had our herd shrink 25 per cent in their milk flow when our silage has given out before we could fill again in the summer with clover, and we have not been able to produce results with green soiling crops to come anywhere near the results secured when matured and cured silage was fed, so that we are positive that silage is the best and most palatable food when rightly made and fed.

A word as to cost and size of silos. Our experience has been that the diameter of a silo should not be over one-half its height, for the best preservation of the silage, or, in other words, a silo 12 feet in diameter should be at least 25 feet high or deep, and one 14, 16, 18 or 20 feet should be 28, 32, 36 or 40 feet high, respectively.

If your herd is small, say 10 cows, a 12 by 25-foot silo would hold about 60 tons, and be ample, if well filled, for that sized herd; 20 cows would need a 16 by 32, holding about 120 tons, and so on, but do not build over 20 feet in diameter, as it makes too much long handling to throw out of silo. Better build two 14 or 16 feet diameter silos instead, and fill one twice in the year, as mentioned earlier in this article.

There are all kinds of silos constructed, but in these days of modern silo construction the circular or round silo is the best, and can be built of staves, stone, brick or concrete. I know of silos constructed of 2 by 4 or 2 by 6 chestnut staves, made from the trees of the farm wood lot and put together as they come in the rough from the local sawmill, held together by hoops, that have given good

service and economy; also the patent, ready-to-put-up stave silo; but for long service and economy, without any of the bother or worry of blowing down in a heavy wind when empty, we favor a round silo made of brick and lined with cement mortar.

Our silos are constructed of what is known as swelled brick, that is, the hard bricks with the bulge in them that can be found at every brickyard, and which cost usually less than half the price of No. 1 brick; and when these are put up with a strong cement mortar, laying five courses of brick in an 8-inch wall, as houses are built, and every sixth course laid as headers across the other courses, and pieces of bent pipe with a large flange on end placed around one-third of the circle of the silo, that is safe to fill for a long term of years. Our first brick silo, constructed this way, has been filled fifteen years, and gives promise of many more years of constant use.

The cost of a silo of this type will vary with the distance from a brickyard or the freight cost on the brick, but as we constructed ours where we hauled the brick seven miles, and contracted for the laying of the brick at $4 per thousand, furnishing the sand for the same ourselves, the structure cost us about $2 per ton capacity, this including the cost of hauling the brick, building the roof, etc. Solid concrete silos can be put up, I think, for about the same cost.

When one considers the amount of food stored up in a 100 to 250 ton silo, and compares its value with the *cost* of a like amount of food stored in the average hay mow, I think they must concede that the silo offers the most economical storage of crops, and certainly will pay for itself very quickly whenever it is adopted on the dairy farm. Build the silo, brother dairymen; use judgment in the construction and size of the same to fit the needs of your herd, and then grow the crops to put into the silo, and do away with the long, laborious, undesirable green-soiling system for summer feeding of your dairy.

DUCKS AND GEESE.[1]

JOHN H. ROBINSON, EDITOR OF "FARM-POULTRY," BOSTON, MASS.

To say that ducks and geese should be grown by more people, and more extensively by many people who now grow them, is only to say what is true as to the growing of all kinds of domestic birds. It is only in a few special poultry growing districts in our own and other countries that the land is producing as much poultry as it should.

There is a widespread impression in this country that those who produce poultry, and especially the farmers who produce the great bulk of our general supply, provide liberally for themselves and their families first; and that what is sold by farmers is all surplus that the producers could not consume. The writer must admit that until very recently he shared this impression as to the general fact, although he knew that many producers did not use poultry and eggs at all freely. But within a year his attention was directed to the report of an agricultural survey which gave statistics for some six hundred farms in a good farming community, near a number of cities in another eastern state, which showed quite plainly that the farmers of that section were producing comparatively little poultry and consuming less poultry and eggs than the average city family in very moderate circumstances, — and that is not very much. The average city family does not use these things very freely. It is the well-to-do people and the high-priced restaurants and hotels and the high-toned clubs that buy the best poultry products the year round quite regardless of price.

Turkeys are not adapted to farms as small as the average farm in this State, but every farmer ought to be able to have for his own table all the fowls, ducks and geese his family want. With other meats at the prices which now prevail poultry grown at home should be cheaper than most of the meats that we buy, though for those who have to buy all kinds of meat it is not to be classed among the cheap meats. The flesh of water fowl is more gamey than that of fowls. It is often said that the meat of domestic ducks and geese retains too much of the flavor of highly flavored things which they eat. This is the case only when they are not managed properly.

[1] Crop Report for August, 1912.

Poultry of any kind will have such flavors if handled the same way. They must be kept where they will get nothing to eat that would give an undesirable taste to the flesh for about two weeks before they are to be killed.

While both ducks and geese like the water and will spend a great deal of time in it if they have the opportunity to do so, they can be grown without water except for drinking purposes. If they can conveniently be given access to water, they are easier to care for, more contented and keep themselves cleaner. But, while both are water birds, their habits are in some things quite different. A duck devotes its attention more to the insect life along streams. A flock of ducks will often follow a little stream for a mile or two, eating the small forms of life in the shallow water and the insects that hover near the surface of the water, and be too far away at night to return home. Ducks will live almost wholly on animal food if they can get it in a fresh, natural condition. One of the most profitable small flocks the writer ever saw was kept at a rendering plant and lived largely on flies, enormous numbers of which swarmed about the decaying meat scraps and filth that were all over the place. About two weeks before killing the young ducks were shut up and fed on grain. The owner said that she had no complaints about the quality of these ducks. Growing ducklings can take meat scraps in quantities that would soon kill young poultry of any other kind and grow remarkably on the heavy diet.

Ducks at all ages stand heavy feeding and close confinement so well that they are better adapted to intensive methods than any other poultry. There are very few farms in this country that grow 10,000 chickens a year. There are many duck farms growing from 15,000 to over 50,000 ducks annually. The ducks grown on these farms are known as green ducks, that is soft young ducks killed as soon as they have grown their frames. At this stage the ducks, if fat, are almost as heavy as they will be when mature and in fair flesh. The mature ducks sold in the markets are mostly from small flocks scattered all over the country.

While geese like the water, the principal part of their food — when they can get it — is tender grass and leaves of vegetables, and they will graze for hours just like sheep. There is an old saying "Geese eat everything before them and foul everything behind them." This does not apply except where too many are kept on a tract of land. Geese are like all other animals in regard to feeding on land too thickly populated. Geese eat all sorts of insects, worms and small creatures found in the water, but do not hunt these as persistently as ducks do. They eat grain readily and are sometimes grown on a diet containing little else. Some come to maturity on such a diet, but it is too heavy for them, and people who try to grow geese without liberal supplies of green stuff usually have con-

siderable trouble. It is this class of growers that is responsible for the idea that goslings are hard to raise.

As they require so much green stuff, and do so much better when they can crop it for themselves, geese are not adapted to intensive methods, and there are no farms devoted exclusively to the growing of geese. Most of the geese on our markets come from small farm flocks. In a few districts nearly all the farmers grow geese to the number of several hundred each year. Where the industry is concentrated in this way the goslings are mostly sold young as green geese. Elsewhere most of the product goes to market when full grown at the winter holiday season.

Those who grow ducks and geese under such conditions that the expense is an appreciable item should always dispose of those that are to be sold before being bred from, as green ducks or geese, as the case may be. They bring a higher price per pound then because they are ready for market at a time when most of the young chickens are small, and there is more profit in marketing them at that age, not only because the price per pound is higher, but because the weight — though not the meat — is then almost as good as it will ever be. Those who grow ducks and geese for their own tables usually kill a part in the green stage, but save more to be killed when they come to full maturity. If much of the food for them has to be bought they are really more costly then than the soft bird that is so largely composed of fat, but they are much better eating.

If not killed in the green stage, when about nine to twelve weeks old, it is practically necessary to keep them until full-grown, because at about three months of age they molt their "chick" feathers and begin to grow the adult plumage. From that time until the adult plumage is complete — between two and three months — they are so full of pin-feathers that it is very difficult to pick them clean. They are also usually very poor in flesh during the early part of this period. Most people find the work of picking ducks and geese very tiresome at best. That perhaps is one reason they are not more generally grown for home consumption. They are much harder to pick than fowls and turkeys at any time but are easier to pick when full feathered than when young. It is, too, largely a matter of being in practice. If people eat a great deal of poultry of their own production they soon become expert enough in picking to get over the eagerness to avoid a job that goes a little hard. Picking poultry for home use is not as particular work either as picking it for market. If a bird is a little torn the quality is not really damaged, but as the appearance is damaged it must be sold for a lower price.

Both ducks and geese lay either in the latter part of the night or very early in the day. Ducks are especially careless about laying in nests. A duck will often make her nest and fuss around it for

hours, then go and drop her egg away from it. For this reason it is the usual practice to keep ducks that are not confined to small yards in the house until about eight o'clock in the morning, by which hour, as a rule, all will have laid that are going to lay that day. A goose, having made a nest, will usually lay in it, but does not like to be interfered with when at her nest.

Ducks are polygamous in mating. It is usual to mate one drake with five ducks early in the season, and when the weather is warm take some of the males away, leaving one drake to eight or ten ducks. Geese, if allowed to do so, would often pair. Young ganders frequently will mate with only one goose. An old gander will mate with two or three more. The males and females mated together show strong attachment for each other, so much so that when a mating is broken up and the birds in it mated with others they often fail to breed the first season.

Where large numbers of ducks are grown, hatching is usually by the artificial method. For small numbers either incubators or hens may be used. Ducks of the large improved breeds very rarely go broody. So if the natural method of hatching is used the duck grower has to depend upon hen mothers. In the early days of duck farming on Long Island, where the industry began in this country, all the hatching was done with hens. In those days 5,000 ducks was considered a large number. After the introduction of machine hatching the industry grew amazingly. Before that it had been given quite an impetus by the introduction of the Pekin duck, which suited the growers better than anything they had previously known, and still suits them better than anything else that has been tried. As these men are in the business for a living it is perhaps not necessary to say that they try everything.

The White Pekin duck is practically the only duck grown especially for market in America. The Rouen duck at maturity is really a better table duck but its dark plumage makes it undesirable for growing to be dressed as a green duck. The Indian Runner duck is the best layer of the duck family. It has been extensively boomed as superior to the hen for egg production, but the claims made for it are based on exceptional performances. It is too small to meet the general demand for a market duck.

Even when coming to maturity early in the fall ducks (with the exception of the Indian Runner) rarely begin to lay until midwinter or after. In fact they will not lay until near spring unless well housed and fed stimulating food. If left to follow their own inclination neither ducks nor geese seek shelter from cold. The duck grower who wants his ducks to lay early houses them at night and during storms, and gives them access only to yards somewhat sheltered from the coldest winds. While the composition of mashes used by different duck growers varies, the differences in ingredients are

not important. A good mash which represents the average is made of corn meal 3 parts, wheat bran 3 parts, low grade flour 2 parts, beef scraps 1 part, root vegetables (cut) 1 part, cut alfalfa, clover or green rye 1 part. This is fed twice a day, night and morning. Some growers give a little cracked corn at noon to ducks that are laying heavily.

Duck eggs take four weeks to hatch. A mash the same as used for the breeding stock may be given the young ducklings from the start. It is customary to mix a little fine grit or coarse sand with the feed for a few days, and occasionally afterwards if the birds show symptoms of indigestion. This seems to be the more necessary when the ducklings are confined to brooder houses or are quite crowded in small bare yards than when they have a run on grass. Some of the best young ducks the writer has ever seen never had grit in the mash, but had plenty of green food at all times.

When young ducks are closely confined the usual practice is to feed five times a day for the first three or four weeks, then four times a day for a like period, and after that three times daily. When they have grass range three meals will be sufficient from the first. For fattening, which usually begins about the eighth week, the ration given above is changed to a fattening ration by omitting the wheat bran and increasing the beef scrap.

For green ducks the ducklings are killed at about ten weeks of age. In the early part of the season, when the price is up and likely to drop quickly at any time, ducks that are well grown may be killed at nine weeks. Later, when the price does not change much, the grower is likely to keep, until they have made all the weight they will at this stage, all ducks not needed to fill regular orders. The weights of ducks at this age run from four to seven pounds dressed.

In New England ducks and geese are dry picked. Elsewhere in the country they are mostly scalded or steamed to loosen the feathers before picking. The consumption of green ducks is still limited mostly to the large cities of the east, but is steadily increasing in them and spreading to other places. As the prices are to some extent influenced by the prices of other meats, there is occasionally a period and sometimes almost an entire season when the duck growers' profits are small, but on the whole the business pays well. Enormous quantities of green ducks go into cold storage in the latter part of each season, when prices are at the lowest, to be taken out as wanted through the period when no fresh green ducks are coming in. The ducks in storage are usually owned by dealers who buy the product of large growers.

The flocks of geese from which most of our market geese come are principally of mixed races. Some growers keep pure Toulouse, Emden or African stock, but in going about goose-growing districts

one is more likely to see flocks that are plainly a mixture of all these with common geese. Sometimes the geese are common or grade geese and the ganders of various pure races. As geese after mating once remain true to their mates some growers mate several kinds separate for the first season and afterwards let all run together. So in these cases what looks like a mixed flock will produce mostly pure goslings of the various races in it.

Growers of geese do most of their hatching with hens in the early part of the season, and use both hens and geese in the latter part. A few people have been successful in hatching goose eggs in incubators, but operations are generally on too small a scale to make it worth while to use machines, especially as the geese lay only a short time in the spring and may as well hatch and rear a brood apiece as not.

The old geese, as has been said, prefer to remain out doors in all weathers. Under ordinary conditions it is as well to allow them to do this, for though they may not lay quite as early, there is no great advantage in getting goslings out before they can have grass pasturage. During the early part of the winter in this section the breeding geese usually do very well on what green food they can get when the snow is off the ground with two light feeds of grain a day. They should not be fed heavily on grain because then they get too fat and the first eggs they lay are likely to be infertile or to produce weak goslings.

About the latter part of February or the early part of March, according to conditions and the weather the geese begin to lay. At this time they should be fed a mash, such as is described above for ducks, once a day, a feed of cracked corn and oats once a day and all the root and leaf vegetables that they will eat. The number of eggs a goose will lay before going broody varies. Some lay only from twelve to fifteen, some twice as many. Occasionally a goose will lay steadily and produce fifty, sixty or more eggs in a season. As a rule, however, after laying from twelve to twenty eggs geese become broody. The usual practice is to set the eggs laid during this first period under hens and break up broodiness in the geese and get them to lay again as soon as possible. When the geese begin laying again they are not likely to lay as many eggs as in the first period and the grower considers this and tries to have eggs on hand to set his geese as they go broody the second time.

When the eggs are hatched under hens each hen is given four or five eggs according to the size of the hen and the size of the eggs. If the hen happens to be very small and the eggs very large, three eggs may be enough. She will hatch stronger goslings than if given four or five eggs, and it is the strong goslings that count. A goose will cover from twelve to fifteen of her own eggs.

The goslings that are hatched with hens require the care of the

hen for only a short time. If the weather is seasonable some growers take the hens away as soon as the goslings are ready to be taken from the nest and put the youngsters in small pens in sunny places during the day and in boxes indoors at night. In any case the goslings will in ten days grow so large that a hen mother is of little further use to them. Goslings reared by hand or with hens should have small movable pens and be moved to fresh grass as often as necessary. They may be fed the same mash recommended for young ducks several times a day, or may have some feeds of this and some of cracked corn soaked in water, or may be fed only the cracked corn. Usually they will grow better with some mash. The principle upon which they are fed should be to let them have all the grass and green food they will eat and what grain they want in addition. There is little, if any, danger of their taking too much of anything else if they have all the tender green stuff that they want. When goslings are hatched and brooded by geese they require very little attention. On a good grass run, with access to a little grain once or twice a day, the geese will bring up their goslings and protect them from most of the enemies of poultry.

Under favorable conditions goslings grow very rapidly. At nine to twelve weeks of age a good gosling should weigh a pound for each week of its life. If they have had good feeding, with a fair allowance of grain, they will be quite fat at that time. If not they should be fattened before killing. Some growers fatten their own goslings but many sell the goslings in a thin state to men who make a specialty of fattening poultry. The birds are fattened by feeding heavily of scalded corn meal or of meal with a little bran and beef scrap added.

The conditions of picking and marketing green goslings are much the same as for green ducks, except that a larger proportion of them are held for the winter holiday trade.

FIG. 1.—An apple tree in which the central leader has been allowed to develop. Such trees are inclined to grow too high. Compare with Fig. 2.

FIG. 2.—The open-center habit of growth. A well-balanced tree with plenty of room for the admission of light and air. Most orchardists favor this type of tree in preference to the type shown in Fig. 1.

PRUNING THE APPLE TREE.[1]

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The Ideal in Pruning.

The architect or builder, before building a house, selects a certain style of structure and this style is followed to the end. The man who would be successful in building up a fruit-bearing structure must also select a style or ideal, and this ideal should be kept constantly in mind throughout the various stages of development. The apple tree is a wonderfully tractable object and may be made to assume almost any shape. Any one who has tried to develop a spreading habit in a Sutton apple tree may disagree with me on this point, for this and some other varieties are sometimes difficult to train, but even the most obstinate cases may be brought under control if proper methods are followed. The methods that have proven successful with some sorts, however, may not be suited to others. For example, a young Greening tree will assume a spreading habit without any special effort on the part of the grower, while a young Sutton will require a severe check in its growth to encourage the production of fruit, the weight of which tends to bring the branches down to a horizontal position.

In the pruning of apple trees there are two distinct styles or ideals, the central-leader type and the open-center type, each with its corps of adherents. Figs. 1 and 2 illustrate these two types of structures. The supporters of the central-leader type claim that it is a stronger structure and not so likely to be broken down by wind and heavy crops of fruit. This is a strong argument, but it is offset by many disadvantages. With certain naturally spreading varieties, like Greening, Tolman Sweet, or Fall Pippin, it works very well, but with the upright growers there is a tendency to grow too tall and to get out of reach of the spraying apparatus. In the west it is a common practice to grow trees with central leaders, and the result is very satisfactory. In the east, however, the climatic conditions are much different, and we require all the sunlight available to give the necessary color to the fruit. The open-center tree admits the maximum amount of sunlight, and with such a tree the work of spraying and harvesting is minimized.

To develop the ideal fruit-bearing structure we must commence

[1] Crop Report for September, 1912.

when the tree is in the nursery row. Here the central leader is cut back and the growth of side branches encouraged. It is well to have the main branches or scaffold limbs well distributed along the stem or trunk, and never should two opposite branches be allowed to develop at the same point, for a crotch formed in this way is likely to split. With most varieties the lowest branch of the tree should be started at a distance of about 20 inches from the ground and the uppermost branch about 30 inches. Three or four main branches are sufficient to form the head.

The main branches are headed in to about 8 or 10 inches when the tree is set. The following season the secondary branches in turn will need to be headed in. The growth may be directed to some extent by cutting back to a bud pointing in the desired direction. In this way a spreading habit may be induced by cutting back to a bud that points outward. Despite such precautions some varieties, especially when making a strong growth, are bound to grow upright. Trees of such varieties should be headed as near the ground as possible, and even then it will be necessary to check their growth in some way.

By regularly cutting back the upright branches and by eliminating the cross branches in the center of the tree an open-center habit may be developed and maintained. Short fruiting spurs should be allowed to develop along the main branches. Watersprouts or "suckers" if headed in will soon develop fruit spurs, and when the center of the tree is kept open the fruit borne here will have an opportunity to develop normally.

Orchard Renovation.

In the mature orchards of the east there appears to have been no effort to follow any particular style. Most of the orchards show signs of having received a few feeble and spasmodic applications of the pruning saw, or, to be more accurate, I should say a few slashes with the axe, and judging from the appearance of the wounds the axe was not always a sharp one. Many of these old orchards, although unprofitable, are in a good sound condition, and with a little judicious pruning, spraying, cultivating and feeding may be put on a profitable basis.

The pruning of these old existing trees, therefore, is the first problem that confronts the apple grower in the east. The work in most cases consists mainly in cutting out the central leader. Of course the remainder of the tree will require some thinning. All upright growing branches should be removed and the long slender branches headed in. All dead branches and stubs should also be cut off closely. Sometimes it will be necessary to clean out and seal up cavities, but if a large proportion of the trees require such surgical treatment it is doubtful whether the orchard will bear the expense. Knot-hole cavities, after being cleaned out, sterilized and having the surround-

ing wood sawn off smoothly, may be sealed up by tacking a piece of zinc over the freshly painted surface. The zinc plate should be slightly smaller than the wound so that the bark will heal over the edge. Coal tar is the substance commonly used for sterilizing and painting the wounds.

This abnormal treatment, however, is "butchery" rather than pruning. When trees have been properly taken care of from the start there is no need for such treatment. Pruning should be regarded as a work of training rather than of correction.

Time to Prune.

Regular annual pruning or training will give best results. A severe pruning once in three or four years upsets the equilibrium of the tree, and in the long run is not economical. As a rule, pruning should be done while the tree is dormant. Some prefer to prune in the early spring for the reason that wounds made at this time usually heal over more readily. If the work is started in the fall it is more likely to get the attention that it deserves, and when the first suitable days for spraying arrive the trees will be ready. An additional advantage of fall pruning is found in that wounds made in the fall have a chance to dry out over winter and may be more effectively sealed up with paint in the spring than freshly made wounds.

Summer Prune to check Growth.

The practice of summer pruning as applied to apple trees is almost unknown in New England. Undoubtedly there are occasions when judicious summer pruning is justifiable, and in the hands of the skillful orchardist it is often a very profitable procedure. It should be remembered that during the growing season it is a devitalizing process and has the opposite effect to winter pruning. It is well known that when trees are making very rapid growth they are not likely to set fruit, and when a tree becomes weakened from any cause it immediately assumes the fruit-bearing habit. Knowing these tendencies there seems to be no better way of regulating the amount of growth than by seasonal pruning. The rule is to prune in winter for vegetative growth and in summer for fruit. When trees are making a strong growth, then summer pruning is recommended. As a rule, the last part of June is the best time for summer pruning. It is seldom advisable to do a complete job at this season of the year, but just enough of the branches should be removed to check the growth. With young trees it is often advisable to summer prune to start them into bearing, but with mature trees the practice is seldom necessary, for sufficient check usually may be afforded by withholding nitrogenous fertilizers and by allowing weeds or some other crop to grow in the orchard.

SOME SUGGESTIONS ON BARN BUILDING.[1]

J. A. FOORD, PROFESSOR OF FARM ADMINISTRATION, MASSACHUSETTS AGRICULTURAL COLLEGE.

The United States census for 1910 gives the value of farm buildings in Massachusetts as $88,636,149. If the value of farm dwellings is omitted and also the buildings on the estates of wealthy men, which are seldom built from the commercial standpoint, there still remains a very large investment, and one that in the opinion of the writer will abundantly repay for much more careful study and supervision than has heretofore been put upon it by the business farmer.

The question of building a modern dairy stable on many farms is complicated by the fact that there are already on the farm one or more barns in a fairly good state of preservation. These barns were considered good enough forty years ago, but owing to the introduction of modern machinery and better methods of caring for live stock and live-stock products, they are now in about the same class as the log cabin or sod house would be for human habitation. These barns are often too good to destroy or pull down and must be used in any scheme of reconstruction if economy is to be considered. On the other hand, the farmer should not forget that labor is a constant and continuous charge, and that any arrangement or device that saves time or labor is worthy of careful consideration. These factors make barn building on most farms an individual problem, but the following general principles may be of assistance.

Location. — The location of the dairy barn should, if possible, be near the center of the cultivated area of the farm, on well-drained soil and so placed that there will be plenty of direct sunlight in the stables, as well as opportunity for a warm, sunny, well-drained barn yard that is protected from the prevailing winds. The question of water supply should also be considered before the location is settled upon. Placing the barn near the center of the cultivated area will save labor in hauling hay, corn fodder and other forage, as well as manure. The public highway often influences the location of farm buildings, but more consideration might well be given to this point. The writer knows of a 65-acre farm in one piece, all of which may be cultivated, where the barns are located at the highest corner of

[1] Crop Report for October, 1912.

Fig. 1.—Young stock barn, Massachusetts Agricultural College. Main barn for hay storage, with gambrel roof. The stable is in the wing and has no storage above it. The trusses shown in Figs. 2 and 3 are the ones used in this stable.

the area, and are considerably over one-half a mile from the further side of the farm; many similar instances could be cited. The desirability of plenty of sunlight in the stables and yards hardly needs comment. It is an excellent disinfecting agent and a valuable aid in maintaining the health of the herd and good sanitary conditions. A well-graded barn yard on soil with good natural drainage is very desirable, and will, in addition to furnishing good conditions for a winter-exercising yard, save much labor in cleaning cows when compared with the quagmires one sometimes sees masquerading under the name of barn yards.

Type of Barn. — It is a fact that an equal amount of lumber will enclose more space when built into a circular barn than any other shape; the round barn when properly built is also strong, convenient, and does not offer as great resistance to the wind as a rectangular structure. The round barn does not offer as good opportunities for enlargement as some others, but aside from this, it is not easy to give logical reasons why it has not come into more general use. The writer, however, is not ready to recommend it without qualification for a dairy barn, but would suggest to those interested a careful study of Bulletin No. 143, of the Illinois Agricultural Experiment Station, on the economy of the round dairy barn. The Illinois Experiment Station is located at Urbana.

Next to the circular structure, a square is the most economical of material, when the walls and floor space enclosed are alone considered. The square, which encloses the same floor as a circle, requires nearly 11½ per cent more wall, while the oblong or rectangular structure, four times as long as the width, giving the same floor space, will require 40 per cent more wall than the circle and 25 per cent more than the square. The reader can easily verify these figures by a little calculation. They are mentioned here in order to call attention to the fact that the long, narrow structure does not allow the most economical use of material employed in construction. The roof, however, can be lighter, but this will only partly offset the additional expense.

Another factor should be considered, and that is the relation of height to capacity. It costs just about the same to build the foundation and roof for a barn with 12-foot posts as it does for one with 20-foot posts, and the latter will thus furnish storage at a much lower per ton rate than the former. Deep mows also hold more per cubic foot than shallow ones, owing to the increased pressure due to extra weight of material. With the modern horse or power hay fork and track available to all, barns to be used for the storage of hay should be built of good height. The height and consequent storage capacity can be considerably increased by using a gambrel or curb roof instead of a gable roof. Figs. 1 and 2 illustrate this point. Attention is also called to the method of framing. Both

frames are made up from 2-inch lumber, and take much less timber than the old fashioned frame. The truss shown in Fig. 2 is very strong, and is placed every 12 to 15 feet, the intervening space being studded with 2 by 6 inch timbers, 20 or 24 inches on centers. The Wing joist frame barn (Fig. 4) is also a strong, rigid structure; many barns have been built on this plan in the north central States and seem to be very satisfactory.

One other question that will need to be settled before deciding on the best type of barn for a given location and purpose is whether hay and other fodder is to be stored over the cattle or not. Considerable objection has been made to this practice in the last few

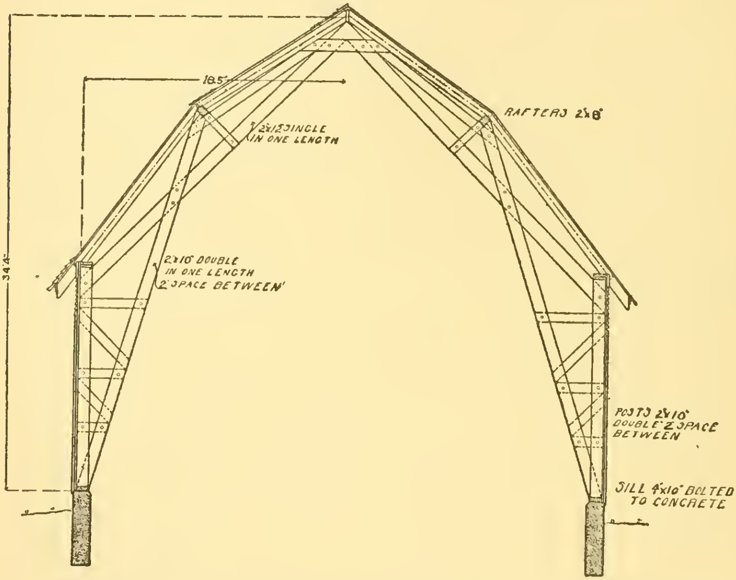


FIG. 2.—Truss to avoid interior posts in a storage barn. These are placed every 12 or 14 feet.

years, and it is probably true that ideal conditions can be more easily maintained in a stable that is apart from the storage barn or attached to it only at one end. On the other hand, it is more expensive, and there is really no good reason why excellent conditions for the production of even the highest grades of milk cannot be maintained in a stable, even if hay is stored above, *provided,* that there is (1) a tight ceiling; (2) a good ventilating system, one that works; (3) a room outside the stable where hay can be thrown down, so that hay is never thrown from the mow directly into the stable, but is drawn in on trucks; (4) plenty of windows so that light and air are admitted on both sides; and (5) that reasonable sanitary conditions are maintained in the stable itself.

The Cow Stable. — The floor of a cow stable should be nonabsorbent, easily cleaned, not slippery, a nonconductor of heat, and durable. A wooden floor does not fulfill these conditions. The most satisfactory floor available to-day for this purpose is undoubtedly made of cement, with some material that is a nonconductor of heat in the stalls where the cattle stand. The writer is inclined to believe that bricks made of ground cork and asphalt are the best material for this purpose; they are laid in hot asphalt and seem to be giving satisfactory results where they are in use. Many dairymen use a cement floor in the stalls as well as in the other parts of the stable, but it is not entirely satisfactory. All slopes and grades where the cattle are to pass should be left rough, that is, given a

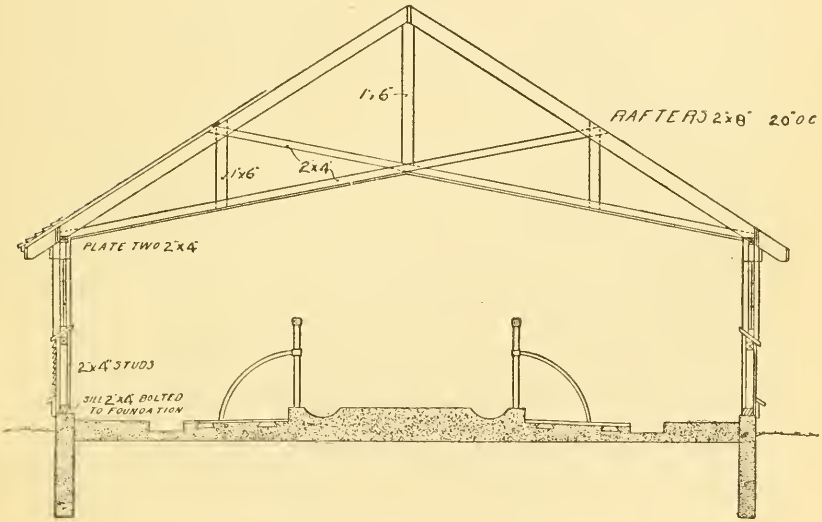


FIG. 3.— A cheap and efficient truss for a stable roof.

float finish. The smooth trowel-finished cement is much more easily cleaned and should be used for the feed floor and mangers, and may be used for the walk behind the cows if ordinary care is taken in handling the cattle. The cattle are more apt to slip on the smooth finished floor.

In the arrangement of the cow stable there should be not less than two rows of stalls if the most economical use of space is desired. Whether the cattle should face in toward the center or out toward the outside walls is a disputed point. In stables built on the latter plan it is possible to drive a cart or manure spreader through the center of the stable behind the cows and load the manure directly from the gutters, thus saving one handling. On most farms, how-

ever, it is not always convenient to have a team available at just the time the stables are cleaned, but it is easy to place a cart or spreader where the modern manure carrier can be dumped into it, and this plan seems to have a number of advantages over the other. If a manure carrier and overhead track is to be used, the best arrangement is to face the cattle toward a center feed walk. The width of a stable to accommodate two rows of cows, including feed floor, should be not less than 34 feet, and better, 36 feet, while 40 feet in width makes a very desirable stable. Stalls should be from 4 feet 6 inches to 5 feet long, only the largest Holstein requiring the latter

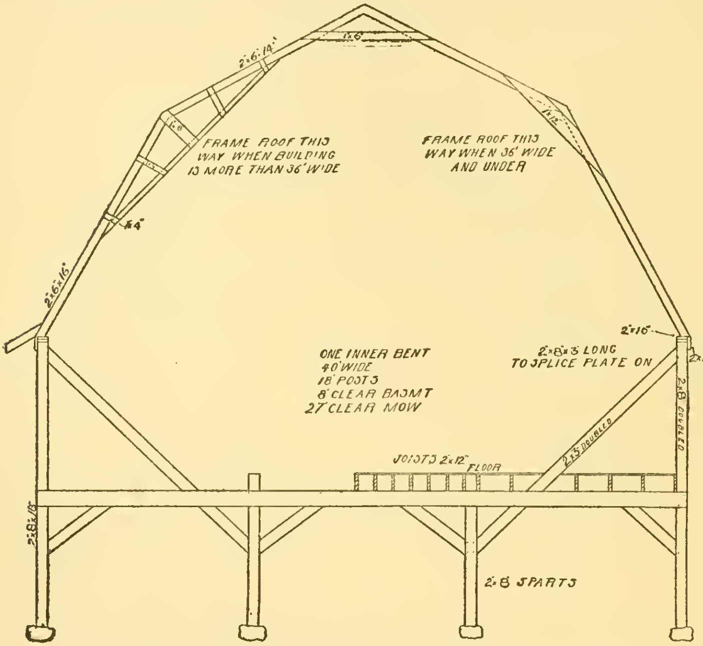


FIG. 4.—Section through a Wing joist frame barn in Worcester County, Mass. Gives plenty of storage and room for an excellent stable beneath.

length. The gutter behind the cows should be narrow enough so that the animal in going into the stall will step over rather than into it; 16 inches is a good width. If the cows face toward the center of the stable, care should be taken to have the walk behind them of good width, at least 5 feet; this is to avoid the wall behind becoming spattered with the droppings and thus increasing the labor in keeping the stable clean and sanitary.

As previously stated, sunshine is very desirable in the modern sanitary cow stable, and plenty of window space should be supplied. At least 4 square feet of glass per cow is desirable. The only ob-

jection to large areas of glass in the stable is the rapid cooling and condensation on very cold nights, and this can be largely overcome by the use of double glazed windows.

Ventilation. — It is stated on good authority that the cow needs to be supplied with twice the weight of pure air that she does of food and water combined. The good feeder tries to furnish as much good food and water as the animal can use to advantage. If the best results are to be obtained, the same policy must be followed with reference to pure air. The problem of furnishing this pure air during the winter months without lowering the temperature of the stable enough to decrease the milk flow has brought into use several systems of stable ventilation. Each system has its advantages, and the best one for any particular instance depends somewhat upon local conditions and the kind of building. Whatever system is adopted, it should be remembered that the warm air in the stable rises to the ceiling. This may be taken advantage of for two purposes: first, to warm the incoming air, and second, to cause a draught in the out-take flue. The best results are obtained in any system when the fresh air is taken in through a number of small openings scattered through the different parts of the stable, and when the out-take flues are few in number and of large size. If the incoming air can be brought in near the ceiling and dropped through the warm air that is always present, it will be an additional advantage. Ventilating flues, especially the out-take, should be tight and well built in order to give the best service. The out-take flue should not be placed where it will be too easily chilled, as this will decrease the rapidity of flow through the flue. It should not be placed between the rafters; if necessary to follow the roof line, a tight wooden flue should be built below rather than between the rafters. Well-built ventilating flues under ordinary conditions will allow the air to pass through at the rate of about 300 feet per minute without mechanical forcing and without the aid of heat other than that derived from the animals in the stable; 3,500 cubic feet per hour per 1,000 pounds of live weight is usually considered about the amount that should be supplied to dairy cattle. This is based upon the assumption that a thousand-pound cow will breathe 2,804 cubic feet of air in twenty-four hours, and that it is not desirable that the air in the stable contain more than 3.3 per cent of air once breathed. It has often been stated that the carbon dioxide thrown off from the lungs which is detrimental if breathed again, settles to the floor. It is a well known fact, however, that when different gases come together a diffusion or mixing begins to take place at once, and this probably happens in the stable. Recent tests reported to the writer indicate that this is the case, and that the carbon dioxide is fairly well diffused throughout the stable.

If there is plenty of window space in the barn, this can be made to furnish excellent ventilation. The Sherringham window is good; this is simply a triangular piece of metal or wood placed at the side of the window so that it can be dropped out at the top and the air be deflected toward the ceiling instead of striking directly on the cattle. The Sherringham window, with double-glazed sash and casing complete can be purchased from some of the dairy supply houses. The removal of the windows and the substitution of cloth has sometimes been recommended; this does not give good results for the reason that the air of the cow stable contains a good deal of moisture and some dust, and the meshes of the cloth very soon become stopped up, so that air does not pass through readily. It is undoubtedly a good method for the sick room.

In conclusion, the writer would urge any one who is planning to build or rebuild a dairy barn (1) to visit as many other barns as he can; (2) to allow for expansion of the business; and (3) to draw plans to scale a year before building operations are begun; the last will save expense, as it is easier to correct mistakes made on paper than those made with actual building materials. In the study of the problem, the following publications may be of service: —

The Farmstead, by Roberts, publisher, Macmillan Company.

Farm Buildings, Sanders Publishing Company.

Physics of Agriculture, by King, published by the author, Madison, Wis.

Ventilation, by King, published by the author.

Bulletin 143, Economy of the Round Dairy Barn, Illinois Experiment Station, Urbana, Ill.

Bulletin 250, College Farm Buildings, Michigan Agricultural Experiment Station, Lansing, Mich.

Bulletin 164, The King System of Ventilation, Wisconsin Agricultural Experiment Station, Madison, Wis.

Circular 131, Designs for Dairy Buildings, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C.

ELEVENTH ANNUAL REPORT

OF THE

State Nursery Inspector.

Presented to the Board and Accepted,
January 7, 1913.

ELEVENTH ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the State Board of Agriculture.

I have the honor to submit herewith the eleventh annual report of the State Nursery Inspector.

A year ago the conditions and requirements of the inspection work were presented quite fully, showing how it had developed and changed during the decade since its establishment. It indicated that both funds and the law were inadequate to meet the conditions existing, that changes were necessary, and that the time had come for a revision of the law in many ways, and for an appropriation sufficient to carry out its provisions. These facts were presented to the Legislature and a new law was enacted covering these points. It only remains to present here a statement of the work of the year 1912 and of new features which have developed.

Inspection of the Growing Nursery Stock. — This portion of the work has changed but little in the last few years. Its purpose is to prevent stock, infested by insects or diseases liable to kill or seriously injure it, being sold to persons not familiar with them, who would therefore be the losers. As such stock sold outside the State is subject to the requirements of the States where it goes, and as the States all have laws designed to protect their residents from purchasing bad stock, such an inspection as meets the requirements of other States is necessary to enable our nurserymen to do business there. Inspection of this kind, therefore, not only protects the people of Massachusetts in their purchases, but is also an essential to the nursery business.

This inspection is not easy to make. To find and recognize 20 or more different insects and diseases in any stage, at sight, requires special training and some field experience.

Men capable of doing reliable work of this kind are not easy to obtain, and the inspection service thus far has been fortunate in finding enough of them to cover the ground in the time available.

The Chestnut Bark Disease. — This disease, which has caused the destruction of millions of chestnut trees through the middle States and New England, has been claimed to be spread by the sale of infected nursery stock. An unusually careful examination of all chestnut trees in Massachusetts nurseries during the past season was therefore made, and it is a pleasure to be able to report that not a tree was found showing any evidence of this trouble.

White-pine Blister Rust. — This dangerous disease of the five-leaved pines was discovered two or three years ago in several shipments from Europe into various parts of this country. Where it attacks young trees their death appears to be certain, and only a matter of a few years. Older trees are seriously affected, often killed, and in any case certain to become almost valueless besides serving as centers from which the disease will spread to all the younger pines around. If this disease were to become established it would mean the destruction of our young pine forests and prevent any successful reforestation of the State with pines such as is now progressing so favorably. Until this year it has been impossible for lack of funds to give this subject any attention, but under the more liberal appropriation now available it seems most important to discover any cases of disease existent and stamp them out while this is yet possible. As all the cases known originated in stock imported from Europe, all such imports for the last four years were located and examined.

The disease is a difficult one to discover, often showing itself as only a local thickening of the bark, together with other unnoticeable characters, for two or three years. After a time, however, it breaks through the bark and forms its spores which are blown about by the winds. At this time it can be found and unquestionably recognized. The inspection, accordingly, became an examination of all the five-leaved pines received from abroad since 1909. In a few

cases unmistakable evidence of its presence was found and every such tree was at once destroyed. In other cases suspicious trees were either destroyed when their owners would permit or were recorded and permitted to remain, pending a further examination next spring at the time when the disease if actually present may be expected to show itself conclusively. The slowness of the trouble in manifesting itself in many cases makes this a difficult disease to handle. The present condition is that all trees certainly diseased have been destroyed; doubtful cases will be examined next spring with particular care; and all the others of this group of trees imported since 1909 will be inspected both next spring and in 1914 to insure the discovery of delayed cases, it being believed that all such will become evident by that time.

In this connection the probability that more cases of the disease were being imported during the spring was recognized, and a close watch of the pine imports was given. That this was justified is shown by the discovery of nearly 25,000 plants in two separate shipments, many of which were already markedly affected. These were at once destroyed, but the possibility of pines infected but not showing the blister rust being sent in was so evident that the only safe method for the protection of the State seemed to be to issue an order that none should be imported. This was accordingly done, the order being effective June 1, 1912, to hold good until revoked. Later, Bulletin 1 of the inspection service was issued, describing the disease and its danger, and was given a wide circulation throughout the State, that persons having plantations of young pines might be on the watch for this trouble and possibly avoid its development in some consignment which had not come to the knowledge of the inspector.

It is a pleasure in this connection to acknowledge the kind assistance of Mr. Perley Spaulding of the Bureau of Plant Pathology, United States Department of Agriculture, who has made a special study of this disease, in the identification of doubtful cases, and advising the best methods of procedure.

Abolition of the Tag System. — The inspector has always had very little faith in the value of the tag system which

has been used by a number of States, chiefly in the south. Under this system a nurseryman desiring to send nursery stock into a State using this system must deposit with the inspector of that State a copy of his official certificate of inspection and purchase tags to attach to his shipments if the certificate is acceptable. The principle involved is, of course, that the official certificate shows that the nursery concerned is in a satisfactory condition, and that no dangerous pests or diseases have been found.

Doubt as to the value of this plan was first raised in the mind of the inspector some years ago by the remark to him of another State Inspector, that, "We care far less what leaves the State than what enters it," and the tag system was inserted in the Massachusetts law in spite of some opposition on his part.

Until the fall of 1911 lack of funds prevented any examination of stock entering the State under the tag system, but that year it was found possible to give some attention to this side of the work, and the results fully justified his opinion. Of the 13 shipments first examined, 11 were found to be in such a condition that they could not be accepted, and if found in Massachusetts nurseries would not have been tolerated for a moment. These shipments were either returned to the shipper at his expense or were destroyed, and the most suggestive fact resulting was that later consignments from the same shippers were in excellent condition. The only conclusion which can be drawn from this is that so long as some nurserymen, at least, believe that what they send out will not be examined, they are willing to sell stock only worth putting on the brush heap, reserving their good stock for places where they know it will be examined.

Under these conditions it is evident that the tag system cannot be depended upon, and the new law has eliminated it. The States of New York and California have for several years taken the position that the only way to protect their citizens from poor nursery stock is to inspect it upon its receipt and after a careful investigation of the results of this method it was made a part of the Massachusetts law. Hereafter no certificate or other statement will be required

for stock entering this Commonwealth, but it will be examined at point of destination and any action taken that its condition requires. The real effectiveness of this method can best be seen by the following remark, contained in a letter from a nurseryman who has shipped a great deal into Massachusetts in the past, which it was probably not anticipated would fall into the hands of the inspector: "We presume there is some way for the nurserymen to get around this law."

The only disadvantage under the new system will be that at times there will be a great deal of work examining these shipments which must be handled very quickly as they will otherwise spoil. Possibly in some cases it may be impossible to get to them all. In any case, however, the determination of what stock is fit to enter Massachusetts rests in our own hands and is not decided by inspectors who may, at least in some cases, "care far less what leaves their State than what enters it."

Outside Inspections. — These have been few during the past season. In some cases certain places have been declared public nuisances in accordance with the terms of the law, and their owners instructed as to how to remove this ban; in others, where conditions were alike for a long distance in all directions, it was manifest that this section could not be considered as applicable to the case, and no action was taken.

United States Inspection Laws. — For several years bills of one kind or another have been presented to Congress, all for the purpose of providing some check or supervision over the importation of nursery stock from abroad. These bills have met with considerable opposition on the part of importers, who feared that their business might possibly be interfered with or even destroyed, and on the part of nurserymen, who anticipated that certain sections of the bills might be so used as to shut off their business with other parts of the country under terms of local quarantine. The Massachusetts inspector has taken no active position on either side of this subject, believing that as an administrative officer it would be unwise for him to do so.

In December, 1911, several meetings of members of the United States Department of Agriculture and persons interested were held, and an agreement was finally reached, based on statements by members of the department as to interpretations which would be made of certain sections of the bill by which opposition was withdrawn and the bill was enacted by Congress, becoming a law effective Oct. 1, 1912.

Under this law two somewhat different subjects are regulated. All nursery stock brought into the United States must comply with certain requirements, and notice of each consignment must be sent to the Nursery Inspector of the State to which it is consigned. In connection with this, power is given to the secretary of agriculture to forbid the importation of plants, etc., liable to bring in with them diseases or insects not already widely prevalent in the United States.

The other point covered by the law is that the secretary may quarantine portions of the United States against other portions, to prevent the spread of insects and diseases, in cases where he may see fit to do so. Both of these parts of the law have such close relations to conditions in Massachusetts that it is well to consider them in some detail.

Imported Stock. — The importance of examining all nursery stock brought into this country was presented in the last annual report. Most of our worst insect pests and many plant diseases have undoubtedly reached the United States in this way. Despite this, many more yet remain which could easily be added to our list, and it is most important to discover any of these when they are first brought in. Probably a dozen different pests have been found during the last three or four years on foreign stock examined as it entered this country.

The Massachusetts inspector has kept as close a watch on all imported stock during the last three or four years as funds and information of the shipments available would permit. By the new United States law notice of each shipment is sent him, and with the larger appropriation available both of the difficulties preventing thorough work have now

been eliminated and imports can be successfully covered hereafter. During the year 2,991 cases of imported stock have been inspected, and all infested plants found have been destroyed or so treated that the insects or diseases present have been eliminated. Probably during the spring some shipments escaped examination, no information of them being received, but during the fall and hereafter this will not be likely to occur.

Quarantine Provisions. — At the time the meetings of the United States officials and nurserymen were held the Massachusetts nurserymen, at least, received the impression that none of the pests present in New England would be considered as coming under the provisions of the bill, being too widely dispersed. This was also the understanding of the situation received by the inspector. In October, 1912, however, notice was received that a hearing would be held at Washington October 30, to consider quarantining all parts of New England in which the brown-tail and gypsy moths occur. This, of course, came as a surprise for which the New England nurserymen were entirely unprepared, and the inspector was deluged with letters and telegrams referring to the matter. It seemed desirable that Massachusetts should be officially represented at the hearing, and His Excellency, Governor Foss, appointed the inspector and Mr. John Farquhar as delegates for that purpose.

A conference the day before the hearing disclosed that the general policy of the government had already been to a large extent determined upon, and that so far as nursery stock within the infested territory was concerned, this was to be inspected by United States inspectors and shipped under permits issued by them. With this as a basis, a determination of the policy the State inspection service should adopt became important. It was evident that so far as the State inspection was concerned the government inspection would have neither any value or significance, for it could touch only stock entering into interstate commerce, and as no nurseryman can tell until the stock is dug, in filling one order after another, which plants will have to leave the State and which remain in it, any government inspection

would of necessity be of shipments after they had been assembled at the packing sheds. From the nurseryman's standpoint, however, the situation would be quite different. Until the passage of the United States law his relations had been entirely with one set of officials, — the State Inspectors. Hereafter he would have two different sets of inspectors to provide for, working probably under different regulations, and in many cases, at least, causing confusion and delay at times in the year when shipments must be rushed to the utmost capacity of the nursery, the shipping seasons being very short. A large number of the leading nurserymen were in Washington for the hearing, and a conference with them was held for these reasons, to determine their attitude. It was found that they were unanimously opposed to two sets of inspections, being of the opinion that it would greatly hamper them in their work, and that they doubted if a government inspection would be of any additional value.

At the hearing itself, therefore, the attitude taken by the nurserymen was that a second inspection by government inspectors would not only be unnecessary but would merely put greater burdens on them with absolutely no benefit, and the evidence they presented was wholly to the effect that the State inspection was already as efficient as government inspection could possibly be; testimony confirming this position was also offered by the officials of other States and of the government itself.

The decision of the Federal Horticultural Board, in charge of the execution of the United States law when finally rendered, was to the effect that stock originating within the territory where the gypsy and brown-tail moths occur must be inspected at time of shipment by government inspectors and government permits issued. In Massachusetts, however, the State Inspectors have also been appointed government inspectors and can issue the government permits.

It is as yet too soon to determine how this plan will work. During the five weeks in which it has been in operation few difficulties have shown themselves, but it has to some degree increased the expense to the State of the work, the requirement that all stock sent out being inspected after it has been

dug having necessitated special trips to quite a number of nurseries for this purpose, when, so far as the conditions at the nursery were concerned, these were absolutely needless. The extra cost of such work in a year cannot at present be estimated, but must be regarded as practically the cost of assisting a large and important industry of the State to continue in business without being hampered to a too burdensome degree by the law.

To accomplish all the work required has been more than could possibly be done by the usual number of inspectors, and assistance was necessary. This has been secured through the kindness of Mr. D. M. Rogers in charge of the government work for preventing the spread of the gypsy and brown-tail moths, who loaned the State inspection service a number of men trained in the work. As the duties of these men were directly in the line of preventing the spread of the moths named, through the shipment of nursery stock, their compensation has been continued by the government, but as their location and work has been controlled by the State inspection service, their expenses have been met from State funds, these being the conditions under which their services could be obtained.

Licenses for Agents. — All persons selling nursery stock in Massachusetts which they do not themselves raise are required by law to obtain agents' licenses. There is no fee for this, the object being to follow up cases where any questionable business methods are employed, or where stock delivered through an agent proves to be not up to the standards required by law. Two hundred and fifty-three such licenses were issued during the year. It is almost impossible to find all nursery agents but knowledge of the law is becoming more general, and it is probable that a few years more will find most of them provided with licenses.

Office Work. — Supervision of the various duties required under the nursery inspection law has required considerable time, and the different phases of the work have so developed as to render it necessary to divide the State into two districts that the most efficient service might be obtained. One district covering all of Massachusetts west of a north and

south line just west of Worcester has been retained by the inspector for the immediate personal supervision of details from his office at Amherst. The work done in the eastern part of the State, so far as details go, has been placed in charge of the Chief Deputy Inspector, Mr. W. S. Regan, who has an office in the rooms of the Board of Agriculture at the State House. This division has resulted in greater efficiency and much saving of time in many cases which require immediate attention, and this policy should be continued. It is a pleasure to commend the work of Mr. Regan and the faithfulness and care with which he has carried out the work placed under his charge. In the opinion of the writer confirmed by a pretty thorough knowledge of what is being accomplished in similar lines elsewhere, the inspection work in Massachusetts is at present not excelled anywhere, and a large part of this has been due to Mr. Regan's efforts in planning and watching even the smallest details. The kindly interest and sympathy with the work shown by the secretary of the Board has been constantly in evidence and has been thoroughly appreciated. Without this, little could have been accomplished.

FINANCIAL STATEMENT.

Appropriation,		$12,000 00
Compensation of inspectors,	$5.381 25	
Traveling and necessary expenses,	4,133 37	
Expenses of inspectors whose salary is paid by United States,	985 20	
Supplies (postage, printing, etc.),	512 14	
Clerical services,	67 30	
Salary of chief inspector,	500 00	
		11.579 26
Unexpended balance,		$420 74

A list of the nurseries in Massachusetts, Jan. 1, 1913, is appended.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

APPENDIX.

List of Nurserymen in Massachusetts, Jan. 1, 1913.

Adams, J. W. & Co., Springfield.
Agawam Nurseries, Agawam.
American Forestry Company (T. F. Borst, 15 Beacon Street, Boston), South Framingham, Mass.
Anderson, Wm. L., Lakeville.
Arnold Arboretum, Jamaica Plain.
Atkins, P. A., Pleasant Lake.
Atwater, C. W., Agawam.

Barnes, Israel, Manchester.
Barr, George L., Worcester.
Barrett, M. W., Hyde Park.
Barrows, Henry H. & Son, Whitman.
Barrows, H. E., Brockton.
Bay State Nurseries (W. H. Wyman), North Abington.
Bemis, A. L., Worcester.
Bloomingdale Nurseries (James E. Draper), Worcester.
Blue Hill Nurseries (Julius Heurlein), South Braintree.
Boston & Maine Nurseries (D. L. Desmond), Reading.
Bowen, W. B., Whitman.
Brandley, Jas., Walpole.
Breck-Robinson Company, Lexington.
Breed, E. W., Clinton.
Briggs, L. H., Smith's Ferry.
Brown, John A., Concord.

Calkins, A. N., North Abington.
Canning, E. J., Nursery Company, Northampton.
Carr, Chas. E., Dighton.
Casey, C., Melrose.
Chaffee Bros., Oxford.
Chase, Henry, North Spencer.
Clapp, E. B., Dorchester.
Clark, G. Aldersey, Waltham.
Colprit, E. S., Arlington Heights.
Concord Nurseries (H. M. Pratt), Concord.
Continental Nurseries, M. J. Van Leeuwen, Franklin.
Coskery, Elmer, Newburyport.
Cutler, Mary E., Holliston.

Davenport, Alfred M., Watertown.
Davenport, S. Lothrop, North Grafton.
Dighton Nursery Company (J. S. Place), Dighton.
Dove, Paul, Wellesley.
Dwyer, E. F. & Son, Lynn.

Eastern Nurseries, Holliston.
Elliott, W. H., Brighton.

Farquhar, R. and J. & Co., 6 and 7 South Market Street, Boston.
Faunce Demonstration Farm, Sandwich, Mass.
Ford, J. P., East Weymouth.
Framingham Nurseries (W. H. Wyman), South Framingham.
Franklin Forestry Company, Line.
Franklin Park Nursery, Jamaica Plain.
Frost, G. Howard, West Newton.

Gates, W. A., Needham.
Gilbert, A. L., Springfield.
Gordon, A. B., Randolph.
Gowing, J. D., North Reading.
Gregory, J. J. H. & Son, Middleton.

Haendler, M. P., South Natick.
Hallen, C. E., East Dedham.
Horne, H. J. & Co., Haverhill.
Horticultural Company, Worcester.
Howard, J. W., Somerville.
Huebner, H., Groton.
Hughson, S. T., Dorchester.

Jahn, H. A., New Bedford.
Jennison, W. E., Natick.

Keen, Cyrus R., Cohasset.
Keizer, H. B., Reading.
Kelsey, H. P.. Salem.
King, R. B., Nantucket.
Kirkpatrick, Geo. S., Winchester.

Lawrence, H. V., Falmouth.
Lesure, W. T., Springfield.
Leuthy, A., Roslindale.
Littlefield & Wyman, North Abington.

MacGregor, James, Braintree.
MacMannon, J. J., Lowell.

Mann, H. W., Stoughton.
Margeson, Ingram I., Westwood.
Massachusetts Highway Commission, The (E. W. Breed), South Lancaster.
Matthews, Nathan, Hamilton.
McCormack, J. J., Malden.
McKenzie, John, North Cambridge.
McMulkin, E., Norfolk Downs.
Mead, H. O., Lunenburg.
Merritt, Charles L., South Weymouth.
Miller, W. & Sons, Lynn.
Murray, Peter, Fairhaven.
Neil, Sam., Dorchester.
Newell, C. F., West Newbury.
New England Nurseries, Bedford.
Nutting, W. G., Weston.

Old Colony Nurseries (T. R. Watson), Plymouth.
Oxford Nursery Company, Oxford.

Paillet. August, Montague.
Palmer, F. E., Brookline.
Pease, Chas., Salem.
Peckham-Whitney & Co., Fairhaven.
Peirce, C., Dighton.
Phelps, F. H., Lee.
Pomeroy, Edw. W., Gloucester.
Pratt, Chas. S., Reading.
Pulsifer, C. Y., Gloucester.

Quinn, Jas., Brookline.

Rea, F. J., Norwood.
Reading & Floramead Nurseries (J. Woodward Manning), North Wilmington.
Rice, C. G. (F. A. Smith, Superintendent), Ipswich.
Richards, C. A., Greenfield.
Richards, J. E., Needham.
Richmond Nurseries (Henry J. Lamke), Pittsfield.
Riley, Chas. N., New Bedford.
Robinson's Sons, D. A., Everett.
Robinson, L. D., Springfield.

Sawyer, F. P., Clinton.
Shaw. Frank H., Rockland.
Smith, Geo. N., Newton Lower Falls.
Southwick Nurseries (Edw. Gillett), Southwick.

Southworth Bros., Beverly.
Spinney, F. W., Haverhill.
State Forestry Department (F. W. Rane), 6 Beacon Street, Boston.
Story, A. T. & Co., Taunton.
Sullivan & McGrath, Dorchester.
Sylvester, G. F., Hanover.
Sylvia, M. B., New Bedford.

Tebbetts, C. H., East Walpole.
Thurlow, T. C. & Son, West Newbury.
Tuttle, A. M., Melrose Highlands.
Twomey, M. T., Franklin.

Walsh, M. H., Woods Hole.
Walters, C., Roslindale.
Ward, Ralph, Beverly.
Warren, Samuel J., Weston.
Westside Nurseries (C. R. Fish), Worcester.
Westwood Nurseries (Anthony McLaren), Westwood.
Wheaton, Frederick G., South Easton.
Wheeler, Wilfrid, Concord.
White, A. T., New Bedford.
Woodhouse, R. H., New Bedford.
Wright, G. B., Chelmsford.
Wyman Nursery, West Hanover.

Yetter, F. J., Greenfield.

FIFTH ANNUAL REPORT

OF THE

STATE ORNITHOLOGIST.

Synopsis presented to the Board and Accepted,
January 7, 1913.

Negro hunters on rice field canal with bag of bobolinks. (Photograph by E. H. Forbush, Georgetown, S. C., September, 1912.) (See page 221.)

FIFTH ANNUAL REPORT OF THE STATE ORNITHOLOGIST.

Educational Work of the Year.

The report entitled "A History of Game Birds, Wild Fowl and Shore Birds of New England and Adjacent States" was published in October. The volume, as issued, comprises 622 pages, and is illustrated by half-tone plates, line cuts and a colored frontispiece. Under the law, the work was distributed to all free public libraries and high schools in the State, to some public officials, to those who contributed material, and the remaining copies are to be sold at $1 each, plus postage. The active demand for the book shows that it fills a want. The third edition of "Useful Birds and their Protection" is almost exhausted, and the revision of this work for publication has been undertaken.

The secretary of the State Board of Agriculture has suggested that the ornithologist prepare a bulletin on rats and methods of destroying them. Many people who have attempted to protect birds have given up keeping cats and their premises have been overrun with rats. Rats are very destructive in summer to the eggs and young of wild birds, particularly game birds. Experiments have been made to determine the best and least expensive methods of destroying rats. The experiments have not been completed, but the bulletin probably will be ready for the printer sometime during the year 1913. Forty-one lectures have been given by the ornithologist during the year. The audiences have aggregated about 5,000 people. This is a lower aggregate than heretofore, which may be accounted for by the large number of storms which happened to occur on the dates on which lectures were arranged.

Bird Study in the Schools.

Bjornson, the Norwegian poet, said in a lecture delivered by him when abroad: —

At home, in Norway, we do not murder any of our song birds. Our children have for years banded themselves together in clubs to protect the birds' nests. But what we gain by this for our fields, gardens and woods is as nothing in comparison with what we gain for the education of our children in weaning them from cruelty and making them the protectors of the little birds. It teaches them to control their feelings and awakens enthusiasm for worthy causes. Their love of destruction we change to magnanimity. In Norway it is the school that teaches children their duty to song birds, and in the schools they form their societies for bird protection.

The example of the schools of Norway should be emulated in this country, and indications are that it will be followed in the future, and many teachers have asked for literature on how to identify birds and how to attract them about the school or home. This demand has been met by the distribution of Nature Leaflets Nos. 12, 15 and 22 to 25, published by the State Board of Agriculture. The demand for bird study in the schools of the country is growing constantly, and efforts are made by educators to meet it. Thousands of teachers each year are taking special courses in bird study and nature study in general in the summer schools. Normal training schools are sending out teachers with some training in these branches. Some States have published books on birds for use in the schools, and the demand for bird books has resulted in the recent publication of low-priced pocket manuals with colored plates representing most of the species of birds inhabiting the United States. In many towns and cities supervisors of nature study are engaged, a part of whose duty it is to foster the study of birds in the schools. The Audubon societies are forming what are called junior Audubon classes in the schools of the country and furnishing the pupils with leaflets descriptive of birds and their habits, illustrated with colored plates and uncolored plates for the children to color. The number of children enrolled in this way seems to be limited only by the resources of the societies that furnish the material.

The great difficulty with our system of education is that pupils do not learn how to use their eyes. They have been accustomed to learning from print and see little in nature

except that which is pointed out to them. The great value of bird study is that it teaches people to find out things for themselves, to see and hear what is going on in nature. It develops the observational faculties which are never trained by the study of books alone.

Some people object to the introduction of bird study, in this age when education in the common schools is beginning to tend toward practical things, on the ground that it is not practical; but this objection cannot be sustained if we teach children in the country how to know the birds, that they may learn which are beneficial to agriculture and which are injurious. We may show them how birds benefit the farmer, fruit grower and forester, and how to attract and protect the beneficial birds. Here is practical teaching, and every teacher of the upper grades, at least, should know how to interest the children in such matters and should be allowed a little time each week to devote to them. The State should publish and distribute to teachers who specialize in nature study a manual of instruction for this kind of work. It would be well, even, to put a small volume in the hands of every teacher. Such a bulletin might be prepared by the State Ornithologist in co-operation with the State Board of Education if an appropriation for printing could be secured.

Correspondence.

Much of the large correspondence of this office is educational, as numbers of people who are interested in the protection of birds apply to the State Ornithologist for information suited to their own peculiar conditions of locality or environment. In this way a great correspondence has grown up, and citizens feel perfectly free to consult the State Ornithologist on all matters pertaining to the protection of birds and the occurrence of unusual birds. Many questions are asked which it is exceedingly difficult to answer, and many trips from place to place are necessary to advise the best methods of procedure under local conditions. Some of the subjects in which many correspondents have been interested are taken up in the succeeding pages.

Large numbers of people are now interested in the agricultural value of birds and the increase of insect pests that follows so closely on the heels of the decrease of birds. The general decrease of a few species of birds in New England this year has been followed by an increase in cutworms, tree caterpillars and grasshoppers, and it is safe to predict that this increase of insects will be still more noticeable in the year 1913. A monthly article on birds and their protection has been given to a large number of Massachusetts papers, and the matter has circulated also throughout New England and has been copied more or less by papers in other parts of the country. Some papers which have not printed the articles as written have used them as the subjects of editorials. These articles have led to considerable correspondence. Many papers which have not printed the articles in full have taken up editorially the protection of birds; some of their editorials show a growing appreciation of present-day conditions, an increasing knowledge of the subject and much interest on the part of editors.

The following extract from a leader in the "Boston Transcript" illustrates this: —

What too many of us fail to appreciate, until the matter is in some way brought forcibly to mind, is that in building cities and in cultivating fields which once were forests, and in otherwise altering the aspect of the surface of the earth, man has interfered with the balance of nature. It is on this account that special efforts are necessary on his part to restore that balance and to make provision for the protection, and to a degree even the housing and the feeding, of the birds who as his allies will prey upon the pests that would otherwise injure his crops. When one comes to think of it the affair illustrates anew the wonderful scheme of nature and the very real relation between beauty and utility. Here once more is a demonstration of the great and practical value from the utilitarian standpoint of that which the lovers of birds would urge partly on other grounds. Just as the intelligent conservation of forests has been shown of practical value in equalizing the flow of streams and in diminishing the severity and disastrous effects of spring floods, so does the preservation of the birds appear a matter which should recommend itself to the hard common sense of those who pride themselves on being "practical men."

The Agricultural Value of Birds.

In a letter recently received from Miss Mabel T. Gage, who has passed two winters in a valley in California, there appears the following statement: —

> I lived always in Worcester, Mass., until two or three years ago. The life here in California has been a great revelation to me. Never in my travels in Europe or Japan have I been in a place where there were so many birds and so few insect pests as here. Except a certain very small scale (and the bush-tits eat that), there are no insect pests. You have but to plant a rose bush and fertilize the soil. Nothing attacks it as far as we can see. I grew up with the idea that this relation between birds and insect pests was universal. The more of one means the less of the other. . . . I was in Cambridge, Mass., about two weeks in August. Should I not be telling the truth if I said that the loss of trees in the college yard was really due to the scarcity of native birds there. I was told that they were killed by an insect pest, a sort of borer. I should like to see an insect of that sort try to get a foothold in the society of the really ubiquitous woodpeckers, flickers and so forth in our beautiful valley.

It is a fact that the trees in Harvard College yard are believed to have been destroyed by the attacks of the gypsy moths, brown-tail moths and borers, and from what we know of the case it seems quite probable that the work of the borers might have been checked and the trees saved had native birds been numerous in the locality.

Mr. C. W. Vibert of South Windsor, Conn., tells me that in 1908, when there was a great pest of tobacco worms in that part of the Connecticut valley, flocks of grackles came and picked up the worms that had been killed by the farmers and also killed many living worms. Kingbirds and red winged blackbirds also ate many and carried more to their young. He has often seen robins killing and eating quantities of these worms. but the flock of grackles seemed to stay about the tobacco fields most of the time, killing worms. Notwithstanding the value of these birds to the tobacco growers, a movement is now under way in Connecticut to have the protection of the law removed from blackbirds.

Mr. O. A. Case of Barkhamstead, Conn., has watched

crows eating cutworms on the plowed lands and among the tobacco plants. They worked at this almost constantly at some seasons and one could see by following the crows where the worms had been taken near the surface of the ground.

Methods of attracting Birds.

The American people are fast beginning to learn that it is not foreordained and inevitable that birds must be exterminated and that it is possible and quite feasible to increase their numbers enormously. A few people here and there are beginning to accomplish something in a small way, but general co-operation in the matter is still almost unthought of.

Mr. Henry Ford, president of the Ford Motor Company, is a bird student as well as a lover of birds, — one who realizes their usefulness and has determined to set an example in the right direction by establishing a bird reservation of his own. Mr. Jefferson Butler, in "Nature and Culture" of February, 1912, tells how the birds are increasing on Mr. Ford's farm. Mr. Ford has purchased a tract of land about nine miles west of Detroit, Mich., containing over 2,100 acres and including many farms, on one of which he was born, and in this vicinity his boyhood days were spent. He has built a dam on the little river Rouge, which causes an overflow that provides nesting places for waterfowl, while the power arising from it runs an electric light plant which supplies power and light to all the farms within a radius of three miles. Wild rice for ducks and other waterfowl has been sown in marshes, and hemp and other seeds attractive to birds are raised on the cultivated farms. Food houses have been erected for winter feeding of birds which are supplied with hemp, millet seed and sunflower seed, and suet is fastened to the trees by bits of wire screen to prevent the larger birds carrying it away. An abundant supply of fresh water is warmed by electricity to prevent it from freezing, so that the birds may drink and bathe. Birds are made to feel at home, given food in abundance and protected from their natural enemies, and they are increasing in numbers. On December 19 Mr. Butler counted 140 tree sparrows, 6

flickers, a pair of cardinals, 12 song sparrows, 1 field sparrow, 2 white-throated sparrows, a flock of juncos, and 60 mourning doves. He also saw, a few days later, 37 nuthatches and 22 chickadees; and during Christmas week 27 species and 423 individual birds were observed. This is only the beginning of Mr. Ford's work. About 5,000 shrubs have been set out along the river bank, and when these begin to bear fruit undoubtedly they will increase the bird population. Mr. Ford's secretary, Mr. E. J. Siebold, wrote me on May 11, 1912, that greater numbers of birds than ever were noticed this spring, and that each year they seemed to increase. Mr. Ford, in his movement to protect the wild-bird life on his acres, has set a commendable example to landowners everywhere.

New methods and new appliances for attracting birds are coming constantly to notice, but most of them are adaptations of old methods or appliances long in use. Recently many people have begun trials of certain contrivances for feeding birds that have been invented by the Baron von Berlepsch in Thuringia or modified from his inventions. In some cases these have succeeded admirably, but for general use those which are provided with a hopper, letting down the food gradually, are most likely to be successful.

The von Berlepsch nesting boxes which have been remarkably successful in Europe have not been found indispensable in this country. Mr. William Brewster, who has experimented with them, finds them heavy and unwieldy and not so often occupied by birds as are some of the boxes of his own make which he has put up. Some of these are rectangular wooden nesting boxes, both painted and unpainted, some are cylindrical boxes made of bark to imitate a section of a tree trunk, and others are made from bark-covered slabs.

One of the most successful recent attempts to colonize birds is that of Mr. George E. Hoxsie of Canonchet, R. I., who is using rectangular boxes and bird houses. The number of white-breasted swallows that have nested with him is remarkable. The following quotation from Mr. Hoxsie's letter shows how successful he has been in attracting birds: —

This has been our banner year, we having had more birds nesting about our farm than ever before, with the exception of robins. I have never known them to be so scarce, and this fall in pastures where red berries abound there are no robins; usually we have from 10 to 15 nests, but this year there were only 4. Our colony of eave or cliff swallows increased to 32 nests this past season; then we had 43 bird houses taken by white-breasted swallows, 18 nests of barn swallows, 3 nests of chimney swallows, 4 nests of robins, 5 chippies, 8 song sparrows, 2 kingbirds, 1 waxwing, 2 orchard orioles, 2 pairs of bluebirds, rearing 2 litters apiece, and last but not least 2 nests of wrens, making for the season with old birds added something like 725 birds, reared within 500 feet of our house, and all this with the simple protection from English sparrows.

Every building on Mr. Hoxsie's place has some sort of a bird residence on its roof, under its eaves or wherever it affords a proper shelter. Mr. Hoxsie is a believer in the principle that birds not only add to a farm's attractiveness, but pay for their keep by destroying the insects which injure trees and crops. Also he finds that his large colony of tree swallows is a protection against hawks. Whenever the hawks come near, the male birds in the colony all start in pursuit, and no chickens have ever been killed by hawks since this colony has taken possession of his bird houses. Mr. Hoxsie is a bitter enemy of the English sparrow, for he has found by experience that sparrows drive out swallows and other birds and that one of the best methods in protecting native birds is to destroy the sparrow. He does not allow an English sparrow to remain on the place.

In June of the present year, I received a communication from Mrs. J. W. Elliott of Needham in which she stated that crested flycatchers have nested again at her home in the bird house used by them in 1909 and illustrated in my last annual report. At her invitation I had the pleasure of visiting the place and verifying her statements.

Miss Frances Vibert writes from South Windsor, Conn., that the birds feed at a table at the upstairs window in preference to one lower, perhaps because the higher window is more out of the reach of cats. Here blue jays, several chickadees that came at call, nuthatches and tree sparrows all

came to a bird table where only peanuts were put out. The tree sparrows all appeared to be as fond of them as the others.

It is hoped that some legislation will be passed by the Legislature of 1913 which will enable towns to employ bird wardens whose duty it will be not only to enforce the law, but also to instruct and advise people who wish to protect birds on their own grounds.

Bluebirds, Robins and Other Summer Birds seen in Winter.

On Feb. 20, 1910, Mr. Arthur P. Stubbs of Lynn wrote me that a friend of his, a farmer living near the line between Swampscott and Salem, had reported a few bluebirds about his farm buildings at times all winter, and had seen them within a week. Mr. Stubbs wrote again on Jan. 3, 1912, saying that he saw a bluebird January 2. He stated that he saw three great blue herons at Forest River, Salem, on Dec. 13, 1911, and a kingfisher at the same place and date.

We have received reports of bluebirds from eastern or southeastern Massachusetts nearly every winter since 1900, but have not been able to verify them. Bluebirds are not uncommonly seen in parts of Rhode Island and Connecticut, where they probably winter (see page 204).

The conditions regarding the wintering of the robin in the north during the winter of 1911–12 were peculiar. The weather being mild and open until January in the north and colder than usual in some parts of the south, robins remained in the north in considerable numbers and were overtaken by freezing snowy weather. I have been unable to learn, however, that any were killed by cold or starvation.

Apparently, it is not uncommon for robins to spend a part of the New England winter in the cedar swamps or in groves of Virginia juniper, — the so-called red cedar. The "Providence Journal" states that over 200 robins passed the winter of 1911–12 on the farm of Dr. H. M. Howe of Bristol Neck, R. I., where they fed very largely on the berries of the juniper, although they were believed to have eaten some grain

and some weed seeds, and picked up some sustenance in the barn yard.

As the cold and snow increased, many robins in the south were driven into the cities and villages to feed on China berries and other berries, where they were killed in large numbers by the people. Statements have been published to the effect that robins are intoxicated or stupefied by the China berries and thus fall an easy prey to the gunner. Whatever the cause, robins have been quite generally scarce, not only in Massachusetts but in many northern States this year, and bluebirds have been much fewer from Pennsylvania to Canada and from Massachusetts to Michigan than they were in the year 1911. They must have suffered very severely in some part of the country from some cause.

Mr. James Henry Rice, Jr., wrote me from Summerville, S. C., on Jan. 21, 1912, that there had been some snow in that region and much cold, but the damage to the birds must have been slight. Fox sparrows swarmed in yards and titlarks were unusually abundant. Many doves were killed and a slaughter of robins occurred, but he feels sure that if any birds perished as a result of cold or storm, there was nothing comparable to the disaster in 1899.

Attracting Bluebirds in Winter.

Mr. George E. Hoxsie states that for several years he has kept bluebirds in winter. He writes on Nov. 7, 1912, that there were as many as 30 bluebirds which seemed to be selecting tenements in his bird houses on that day. He states that from 20 to 30 birds usually remain about his place during the winter, passing the night in his bird houses and going out over the country to feed during the day. Some of the excrement, taken from his bird houses in winter, was sent to the United States Department of Agriculture in order to determine the character of the food. Mr. W. A. McAtee of the Department of Agriculture examined the excrement and found it to contain 66 seeds of bayberry (*Myrica carolinensis*); 63 seeds of nonpoisonous sumach (*Rhus glabra* or *copallina*); 11 seeds of poison ivy (*Rhus Toxicodendron*);

1 seed of greenbrier (*Smilax herbacea*); 2 clover leaf-weevils (*Phytonomus punctatus*); bits of carabid, ant and grasshopper. Evidently the berries of the bayberry and sumach were the principal food. These may be found in winter all along the coast region in southern New England. Therefore the food conditions apparently are not unusual in Mr. Hoxsie's vicinity. This shows that the wintering of bluebirds in New England does not depend entirely upon the food supply, as all these food constituents might have been obtained farther north and east than Rhode Island. While the abundance of seeds may have had something to do with the staying of the bluebirds in Rhode Island, the probability is that the bird houses in which they spent the night had a greater influence with them. It is interesting to note that Mr. Hoxsie cleans and paints his bird houses every year. The effect produced does not agree with the statements so often made that paint is obnoxious to birds, and that bird houses should not be cleaned out after the birds have nested.

Feeding the Winter Birds.

Many people now feed birds in winter. In some neighborhoods several neighbors are engaged in this pastime, and in most sections of the State a part of the people are taking up winter feeding. This was a great help to the birds in the severe winter weather of January and February, 1911–12, and they gathered to these feeding places in considerable numbers. Mr. E. M. Pedrick of Beverly writes on March 25, 1912, that "since the last snowstorm" he had attracted over 100 tree sparrows with juncos, grackles, woodpeckers, chickadees and one creeper. Most of the birds, he says, come to the window, eat the meat off the bones that are hung up for them, and have learned to be fond of wheat bread, remaining from early morning until dusk. On the occasion of the first severe storm of the winter a letter by the State Ornithologist was sent out to the press requesting people to feed the birds. A great number of people began such feeding at that time and most of them continued it through the severe weather. Had any one realized that the wild fowl

were in any danger of starvation, measures might have been taken for their relief. Some grain was distributed for wild fowl by officers of the Massachusetts Commission on Fisheries and Game.

Miss M. R. L. Sharpe of Chestnut Hill, Mass., writes: "Birds like nothing better than a cocoanut halved and hung so they can eat it. It contains the fat they seek in suet, and is a much pleasanter thing to have hanging about than a piece of the carcass of a slaughtered cow. In the blizzard, on Tuesday," she says, "I added to the bread and seeds for my veranda visitors a piece of the clean, pure vegetable cooking fat, made from cocoa and palm oil, and never have I heard such praises twittered except in early spring."

The Enemies of Birds.

Much correspondence is received annually in regard to the natural enemies of birds. Those who are interested in this subject are referred to the bulletin on "Decrease of Birds," published in the report of the Massachusetts State Board of Agriculture for 1904.

Probably not enough attention has been given to field mice, wood mice and shrews as enemies of birds. Mr. M. A. Walton, Gloucester, writes that many times he has caught the white-footed mouse destroying the eggs and young of birds. In the spring of 1899 he watched a white-eyed vireo's nest. When the young birds were two days old he heard the old bird crying just at dusk one night and found two mice trying to get up to the nest. He drove the mice away, but the next morning found one-half the dead bird in a shoe in his cabin where the mice had carried it. Investigation showed that the nest had been robbed. In the winter of 1904–05 he secured a tree sparrow that had been injured by a hawk. He took it to his cabin and the white-footed mice killed it that night and he found parts of the body of the bird in his shoe the next morning and a pile of the feathers and the bones on a shelf near where it had roosted. He found by placing birds' nests with young for safety in the cabin at night that these mice destroyed them

unless they were protected in such a way that mice could not get at them. These mice are expert climbers, and frequently drive birds out of their nests in hollow trees and seize birds' domiciles for their own use. Mr. Walton finds that practically all snakes eat birds and believes that he has observed that after winters unfavorable for snakes birds increase, but when the snakes pass the winter well, birds decrease the next year. All observing persons will agree that the larger snakes are destructive to young birds.

Mr. A. L. Wood of Wellesley, Mass., writes that squirrels have destroyed the young and broken up the nests of the scarlet tanagers, have driven away the bluebirds from the Wellesley College grounds, and that the blue jay is about the only bird that is hardy enough to hold its own against them. He sends a newspaper clipping which states that a large gray squirrel climbed to the top of a bird house on Washington Street and took out the eggs and ate them, regardless of the anxious birds that were trying to drive him away.

Mr. George F. Deroo of Melrose Highlands writes that a gray squirrel there is known to have eaten the young of a pair of scarlet tanagers, broken up the nest of a pair of blue jays and broken the eggs, just about ready to hatch, of a red-eyed vireo. Squirrels and crows often are very destructive to the eggs and young of small birds.

Mr. Robert N. Lester of Cambridge states that he has seen on the grounds of a public institution, where no shooting is allowed, a crow taking the young of a small bird from the nest; also he says he has seen a crow take the pigeon eggs from a nest over the front door of the Children's Hospital, Huntington Avenue, Boston, in spite of efforts of several of its companions to get them away. He states that he has seen crows taking eggs in Boston Common and on the Harvard College grounds, Cambridge. He states that a friend of his in Cambridge saw a crow attempting to take a young robin from a nest close to the house. This is a common habit among crows.

Bird Killing by Foreigners.

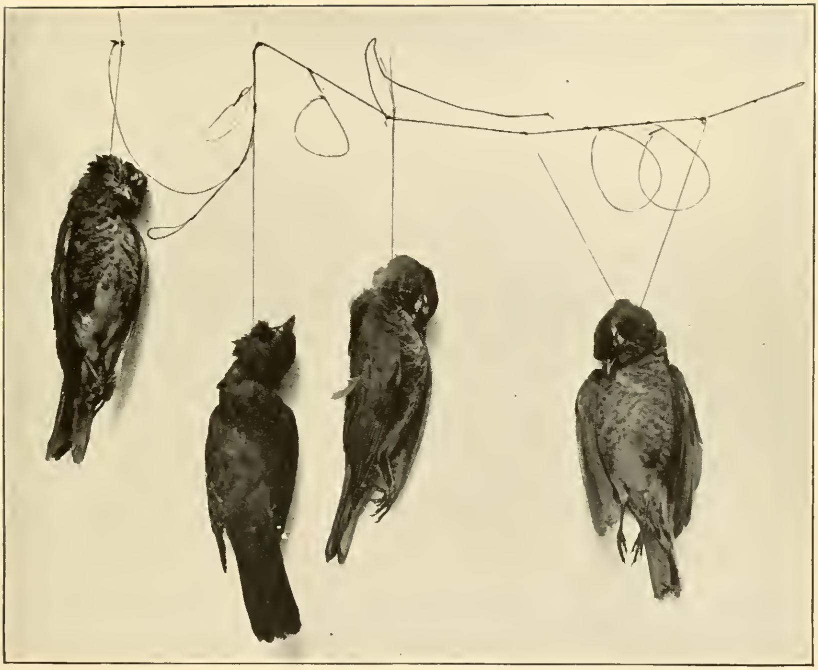
The year has been replete with complaints regarding the killing of small birds by foreigners, particularly Italians.

The hunter's license law, passed some years ago, greatly reduced the number of foreign gunners, as under this law unnaturalized foreigners cannot legally hunt. Now, however, foreigners have devised ways of evading the law by using firearms that are almost noiseless, or other devices that are entirely so. Their depredations call for the constant activity of many wardens, for they kill many parent birds in the nesting season and leave the young in the nests to starve. It is interesting to note some of the devices that they use for killing birds quietly.

Dr. R. W. Schufeldt of Washington writes that while living in New York City a few years ago his attention frequently was invited to the fact that great numbers of birds were killed by the Italian workmen employed in the environment of the city, and he was told that they were using for the purpose of killing birds a form of blowgun as well as bird lime. It is well known that a certain form of blowgun can be used with great effect on small birds by an expert marksman.

A deputy game commissioner took a large net which had been stretched by some Italians near a pond to catch the birds that came to bathe and drink. Huge nets are used in Italy, stretched across the country for long distances and reared high in the air to catch swallows and other birds.

Another means that is used for taking small birds is the horse-hair snare. These snares, when set in trees, are almost impossible of detection until after the birds are caught, and by skillfully baiting them some of these foreign "sportsmen" are able to catch many birds. The robin is one of their chief game birds, and is easily taken by them in these snares, as shown in the illustration.



Robins caught in snares set by an Italian. (From report of the Massachusetts Commission on Fisheries and Game for 1911.)

The Starling.

The European starling is increasing rapidly. It has been reported from several localities in eastern Massachusetts, is scattered through the western counties and is said to have occurred in southern Vermont and southern New Hampshire. Next year we may expect to find it sparsely distributed over the greater part of this Commonwealth. Reports from States where it is now numerous indicate that it will be more detrimental to our own birds than the English sparrow has proved to be.

Mr. William H. Varney writes from Long Island, N. Y., that the starlings destroy a great many insects and a certain amount of fruit, particularly apples, but probably not more than any other bird would take if equally abundant.

Mr. W. S. Bogert, who was formerly a friend of the starlings, wrote me on Nov. 4, 1911, that they were seen in large flocks in Leonia, N. J., all that spring and summer, and that they certainly had driven the native birds away. He says he does not remember a season when he has seen so few birds around his place. He now believes the starling should not be given protection.

Miss Laura F. Craft of Glencove, Long Island, wrote on Nov. 6, 1911, that the starlings had increased enormously there and bade fair to become a dreadful pest. She stated that in September and October they gathered in huge flocks in a swamp near by and did much damage to apples and corn in the neighborhood. "We have," she said, "quite a large orchard and have to shoot frequently into the flock to drive them away from the trees. In spite of that, many dollars' worth of fine apples were pecked and ruined." Similar complaints have been received from Massachusetts farmers.

Mr. E. G. Kent of East Orange, N. J., stated that a pair of robins which had a nest in an elm near his house were attacked by a starling and driven away.

Miss Alice V. Winslow writes from Framingham that starlings drove the flickers away from a nest in Swansea,

Mass., in the summer of 1912 and occupied the nest. This is the first instance that has come to my attention of the nesting of starlings in eastern Massachusetts, but the occurrence of the bird has been reported from several counties.

Are Birds killed by spraying Trees?

Reports of the finding of dead birds under trees sprayed with insecticides continue to come in, but no great numbers of birds have been found in any case, and two years' work investigating the subject leads to the belief that very few birds are killed by spraying. Nevertheless, spraying undoubtedly drives out birds. If thoroughly done, it destroys a large part of their insect food, and they must look elsewhere for it.

Mr. Charles A. Dean of Wellesley Farms writes that in the spring of 1912 many catbirds, brown thrashers and ground sparrows were nesting on his place. After the trees had been sprayed twice nearly all disappeared. Only two birds were found dead (a bluebird and a sparrow), but he says that he has never seen such an almost entire absence of these birds as during the summer after the spraying was done. He has about 125 acres, and his neighbor, Mr. Hubbard, about 300, a large part of which has been sprayed. He is satisfied that the birds were destroyed by spraying and he will not spray again. He states that the spraying was done so heavily that some children who picked and ate berries on Mr. Hubbard's land were all poisoned, although the doctors saved their lives. The entire family was taken ill. When trees are sprayed very heavily with a strong mixture of arsenate of lead, it is unsafe for cattle to graze under the trees, and such spraying may endanger birds, as they may eat poisoned insects or poisoned vegetation or drink poisoned water.

The Artificial Rearing of Game Birds.

For several years the State Ornithologist has been interested in an attempt to establish a large reservation for the propagation and protection of game and other birds. In

Cage for ruffed grouse on the game farm of the American Game Protective and Propagation Association at Carver, Mass. (Photograph by E. H. Forbush.)

Interior of cage on game farm of the American Game Protective and Propagation Association at Carver, Mass., superintendent's daughter feeding ruffed grouse. (Photograph by E. H. Forbush.)

1911 a tract of between 5,000 and 6,000 acres of land in Plymouth County was purchased for this purpose by some friends of the birds, but means for carrying on the work were not then forthcoming. The Massachusetts gentlemen who first underwrote the property have finally leased it to the newly organized National Game Protective and Propagation Association. This society now has begun there the propagation of game birds. Following the example of English game keepers, a beginning was made with pheasants and mallard ducks. Many mallards and pheasants have been reared, but the most interesting part of the experiment consisted in attempts to rear native wild ruffed grouse and bobwhites. In a small way these experiments with native birds have been successful. A considerable number of wood ducks have been reared, two families of bobwhites and one family of ruffed grouse, and something has been learned regarding the methods of handling native birds. Meanwhile the State Ornithologist of Connecticut, Mr. Herbert K. Job, has conducted an expedition to the Canadian Northwest for the purpose of securing the eggs of native wild fowl and rearing the young so as to secure a stock of birds untainted with the natural wildness of the species. He has brought his birds back to Connecticut, and most of them have been reared with little difficulty. The experiments that have been made by the Massachusetts Commissioners on Fisheries and Game, by similar commissions of other States and by private individuals in many States lead to the belief that eventually we shall learn how to rear many native game birds in large numbers.

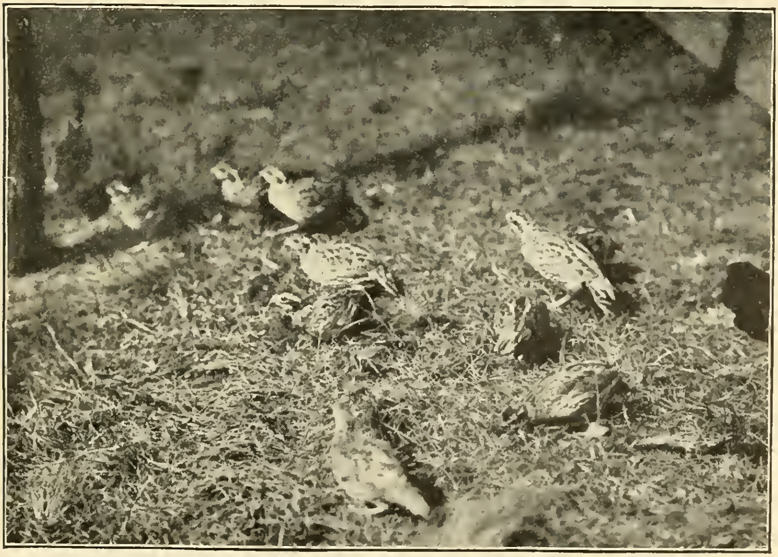
The Legislature of Massachusetts, following that of New York, passed a law in 1912 which prohibits the sale of native wild game birds after Jan. 1, 1913, except such as are raised on game farms and tagged when marketed under regulations to be made by the Fish and Game Commission. This will encourage the rearing of game, and it is to this source that we must look for game for market in the future. The rearing of game on enclosed grounds for the markets is just beginning in this country. Those who have succeeded in

this enterprise find the new sale laws now in force in New York and Massachusetts of great advantage to them in their business. These laws should encourage game rearing and largely increase the number of game birds in the State.

The Summer Shooting of Shore Birds.

The law in Massachusetts no longer allows the killing of shore birds in July, but it is still legal to shoot them in August. There are many reasons why this shooting should be stopped. Several species which are in danger of extinction pass south along our coast in August. Shooting in August is participated in by boys, clerks and many others who are then on their summer vacations and who take up shooting merely because they have nothing else to do. Many of these people do not distinguish one bird from another, and if allowed to shoot shore birds in summer they will shoot many other birds that are protected by law. Many instances where this has occurred have been brought to my notice. Mr. Warren E. Carleton writes from Lebanon, N. H., that he spent a part of August at his home at Plymouth, Mass., and during the 1st, 2d and 3d of August camped on Plymouth beach. On the morning of August 1 the open season on shore birds began, and a horde of gunners of all ages swarmed to the beach. Shore birds were scarce, but tree swallows and barn swallows were flocking overhead, hovering about the gunners and offering easy targets. Gunners confined most of their efforts to the swallows, leaving the little bodies on the beach for the sand fleas. He suggests that a delegation of wardens be sent to the beaches when the next shooting season opens. The summer shooting of shore birds has resulted in the killing and wounding of several people within the past three years, mostly women and girls who frequent the beaches in summer. Gunners drive from one beach to another in automobiles and hunt along beaches where people are bathing and boating. The small sandpipers or "peeps" are the principal game. These little birds are harmless and useful creatures, very beneficial to agriculture in their migrations through the States of the Mississippi valley in spring, and useful along our coasts in destroying

Young mallards raised on the game farm of the American Game Protective and Propagation Association at Carver, Mass. (Photograph by E. H Forbush.)



Young bob-white raised on the game farm of the American Game Protective and Propagation Association at Carver, Mass. (Photograph by E. H. Forbush.)

the larvæ of mosquitoes which increase in our marshes as these birds decrease. They should be taken from the game list and shooting them never allowed. It is distressing to see these little birds dragging themselves along the beach, wounded and crippled by this useless, harmful and destructive form of shooting. It is not a wholesome spectacle for our children during their summer vacations on the beaches to see full-grown men shooting harmless little birds.

Federal Protection of Migratory Birds.

It is recognized by all who are interested in bird protection that federal protection of migratory birds is desirable, if an arrangement can be made to secure it. No action on the matter has yet been secured by Congress. New York, Massachusetts and most of the other States of the Union have memorialized Congress in favor of the protection of migratory game birds, and the McLean bill for the protection of migratory birds, under fixed regulations to be made by the United States Department of Agriculture, appears to have some chance of passing at the present session of Congress. Its fate will be decided before this report is published. If it fails, the friends of the measure can reach success only by continuous and persistent work year after year.[1]

The Destruction of Northern Insectivorous Birds in the South.

Mr. James Henry Rice, Jr., chief game warden of South Carolina and secretary of the South Carolina Audubon Society, wrote me on Oct. 28, 1910, as follows: —

I have intended for some time to write you, setting you straight. In your book, "Useful Birds and their Protection" (page 320), you say that the bobolink inflicts a damage equal to $2,000,000 on the rice crop, and would destroy the whole crop were not all the hands on the plantations employed shooting and frightening the birds.

The destructiveness of the bobolink to rice I do not question, but I deny the necessity of killing them, and assert of my own knowledge

[1] Since the above was written the McLean-Weeks bill, placing migratory game and insectivorous birds under federal protection, has been inserted in the agricultural appropriation bill and has passed both Houses of Congress.

that the birds were never killed to prevent the destruction of rice, but for market, and the figure given is ridiculous.

The greatest rice crop of South Carolina (the other Atlantic States are negligible) since the war, was raised in 1880 when, according to the United States Department of Agriculture, the amount grown and harvested was 52,077,515 *pounds!* Counting this, in round numbers, as 900,000 bushels (rice was then worth 40 cents a bushel to the farmer) this would be $360,000 worth of rice, although they claimed it as worth above $500,000, — a long way from $2,000,000 all told. Not a fourth of this is grown now.

Bendire quotes my old crony, Capt. Miles Hazzard, as to the destructiveness of the bobolink, and Captain Hazzard gives the usual picturesque description of the coast planter, to which Audubon lent ear and made errors in plenty.

At the time he wrote, Captain Hazzard had gone down before a worse foe than bobolink or caterpillar, to wit, the rice-field negro, whose sullen listlessness ruined every planter on the coast. Captain Hazzard had failed and his place was owned by a New Yorker.

Now as to the facts. The bobolinks (first flight) arrive on Waccamaw River, opposite Georgetown, on August 21, with almost unfailing regularity. Small negroes fire at them with muskets, charged with powder only, since, if allowed to kill the birds, the negroes would stop to pick them up and thus allow the other birds time to feed.

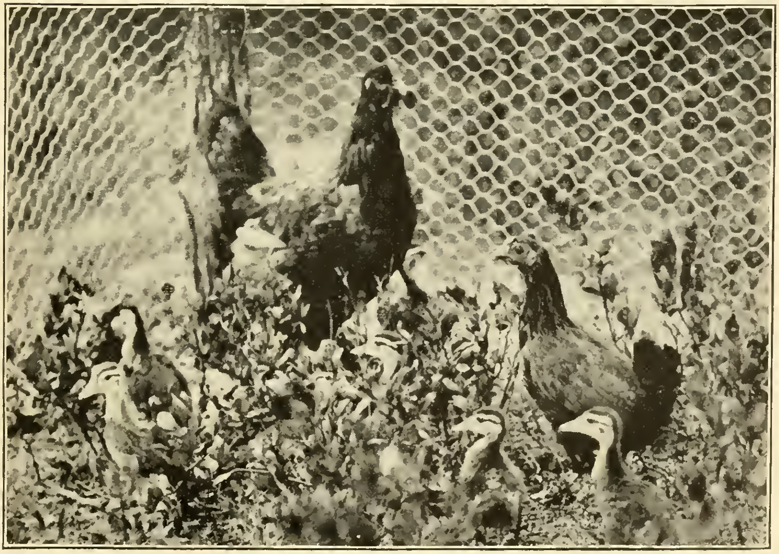
Not a bobolink (ricebird) is killed until they are plump and ready for market, when negroes go along the irrigation ditches at night and pick them off. At first it may be necessary to thresh them off with a brush (branches cut for the purpose), but later they are caught, their necks pinched and they are dropped into the boat. Next morning they are taken to Georgetown where a large company has them picked, sorted and shipped, getting $1 a dozen and sometimes more, net.

One year there were 60,000 dozen shipped! The rice has passed the stage where the birds can do harm when they are taken for market. About 20,000 dozen Carolina and Virginia rail are also shipped annually. The bobolink industry is falling off necessarily for want of bobolinks. As one of the most biased planters remarked to me the other day, they are no longer a menace, hardly more than an annoyance.

If the rice industry is ever revived in South Carolina it will be revived along lines similar to those in Louisiana and Texas, but revived only after the rice-field negro has been forced to emigrate.

If $2,000,000 is an exaggerated statement of the annual loss caused by the bobolink, there seems to be good authority for it.

Nesting box for wood ducks on the game farm of the American Game Protective and Propagation Association at Carver, Mass. Wild ducks nest in these boxes. (Photograph by E. H. Forbush.)



Young wood ducks reared by bantam hens from eggs laid by birds in confinement on the game farm of the American Game Protective and Propagation Association at Carver, Mass. (Photograph by E. H. Forbush.)

In Farmers Bulletin 54, published by the United States Department of Agriculture, we find the statement that the annual loss to rice growers has been estimated at $2,000,000.[1] In the report of the Commissioner of Agriculture for 1886 the statement again appears that the aggregate annual loss that birds occasion in the rice fields is about $2,000,000.[2]

Inquiry was made of Dr. T. S. Palmer, assistant chief of the Bureau of Biological Survey, United States Department of Agriculture, as to the facts. In a letter dated Nov. 3, 1910, he writes as follows: —

> I think you will find that the statement regarding the damage done by ricebirds is fairly accurate. The difficulty is that those who have quoted it have failed to realize that it was based on data collected twenty-five years ago, and that conditions have since changed materially. You will find the matter fully explained in the report of the Department of Agriculture for 1886, page 247. The facts are briefly these: the data collected during the year 1885 showed considerable losses sustained by rice growers, variously estimated to be from 30 to 50 per cent of the value of the crop. The best statistics available at that time were those of the tenth census for the year 1879–80. These figures showed that South Carolina produced in 1879–80, 52,077,515 pounds of rice, out of a total production of 110,131,373 pounds. At 6 cents a pound, apparently not too high a value for that period, the value of the crop was $6,607,-882.38. In 1909 South Carolina produced 476,000 *bushels* of rice valued at $433,000 out of a total crop of 24,368,000 bushels valued at $19,341,000. Most of this crop was produced in the States of Louisiana, Texas and Arkansas. The fact is that the great rice-producing area has moved west in the last twenty years from the Atlantic coast to Louisiana and Texas, and figures applicable to conditions in 1885 should not be quoted for the coast States to-day without explanation.

On page 248 of the report of the Commissioner of Agriculture for 1886, is a letter from Col. John Screven of Savannah, Ga., president of the Georgia Rice Growers Association, which reads in part as follows: —

> The ricebird is strictly migratory. It appears on the Savannah River commonly about the 10th or 15th of April, and remains, per-

[1] Farmers Bulletin 54. "Some Common Birds in their Relation to Agriculture," by F. E. L. Beal, May, 1897, p. 18.

[2] Report of the ornithologist and mammalogist. Report of the Commissioner of Agriculture, 1886, p. 247.

haps, until the 29th of May. During this incursion it is known as the "May-bird." It appears again about the 15th of August, when the early grain is hardened and is not so inviting to his appetite as when unripe and in the milk. The planter, observing these dates, seeks therefrom to seed the land and to have the young rice under what is known as the "stretch flow" before the spring flocks arrive, and to have the grain ripened before the autumn flocks return. If his planting is not finished before the spring flocks come, it will be delayed until late in May or early in June, when the birds have departed for the season. He looks to the ripening and harvesting of such late crops when the fall ravages of the ricebird have either ceased or are much diminished. . . .

Despite the precautions so taken, its invasions are ruinous to fields on which its flocks may settle, especially if the grain is in palatable condition and is on fields adjacent to marshes convenient for ambush or retreat. Bird-minders, armed with muskets and shotguns, endeavor by discharges of blank cartridges to keep the birds alarmed and to drive them from the field. Small shot are also fired among them, and incredible numbers are killed; but all such efforts will not prevent great waste of grain, amounting to a loss of large portions of a field, — sometimes, indeed, to its entire loss. The voracity of the bird seems so intense that fear is secondary to it, and they fly, when alarmed, from one portion of the field to another, very little out of gunshot, and immediately settle down again to their banquet.

As evidence of the numbers present of this bird and of the numbers killed in the rice fields, a neighboring planter informs me that in 1884 he permitted four pot-hunters (contrary to the ordinary régime) to shoot in his fields, and in the course of the fall season they slaughtered and accounted for 8,000 ricebirds.

A part of the above statement seems to show how the rice planters might avoid injury by the ricebirds through early planting. But it is clear that for some reason early planting is not always done.

In the same report appears a copy of a letter from Capt. Wm. Miles Hazzard, Annandale, S. C., from which the following is an extract: —

The bobolinks make their appearance here during the latter part of April. At that season their plumage is white and black, and they sing merrily when at rest. Their flight is always at night. In the evening there are none. In the morning their appearance is heralded by the popping of whips and firing of musketry by the

bird-minders in their efforts to keep the birds from pulling up the young rice. This warfare is kept up incessantly until about the 25th of May, when they suddenly disappear at night. Their next appearance is in a dark yellow plumage, as the ricebird. There is no song at this time, but, instead, a chirp, which means ruin to any rice found in milk. My plantation record will show that for the past ten years, except when prevented by stormy south or southwest winds, the ricebirds have come punctually on the night of the 21st of August, apparently coming from seaward. All night their chirp can be heard passing over our summer homes on South Island, which island is situated six miles to the east of our rice plantations, in full view of the ocean. Curious to say, we have never seen this flight during the day. During the nights of August 21, 22, 23 and 24, millions of these birds make their appearance and settle in the rice fields. From the 21st of August to the 25th of September our every effort is to save the crop. Men, boys and women are posted with guns and ammunition to every four or five acres, and shoot daily an average of about one quart of powder to the gun. The firing commences at first dawn of day and is kept up until sunset. After all this expense and trouble our loss of rice per acre seldom falls under five bushels, and if from any cause there is a check to the crop during its growth, which prevents the grain from being hard, but in milky condition, the destruction of such fields is complete, it not paying to cut and bring the rice out of the field. We have tried every plan to keep these pests off our crops at less expense and manual labor than we now incur, but have been unsuccessful.

If Captain Hazzard's statement that the loss per acre seldom falls under five bushels is not greatly exaggerated, and if the rice crop of the United States was worth $6,607,882.38 for the year 1879–80, it seems that $2,000,000 would be a fairly conservative estimate for the loss occasioned by bobolinks in that year, especially if the injury done the rice fields, and the cost of bird-minding were to be added; but the statement by Mr. Rice, that the rice industry of the eastern coast is rapidly failing, puts a new face on the matter.

Prof. Charles E. Chambliss, expert in charge of rice investigations of the Department of Agriculture, furnished me with statistics of the rice industry in South Carolina for 1907, 1908 and 1909. The farm value of the commercial rice crop was $552,000 in 1907 and $433,000 in 1909. In

1907 there were 19,000 acres under cultivation and in 1909, 18,600. Mr. Rice also states that Georgia in 1909 had 5,000 acres in rice and North Carolina had 1,000. He figures that with a total of 24,000 acres from the South Atlantic States, a crop of 30 bushels to the acre and $1 to the bushel (both of which he believes too high), the rice industry for the South Atlantic States would not produce $750,000. Regarding this he writes as follows: —

Knowing what I do of the local conditions I expect to see South Carolina's acreage cut more than one-half another year. As a matter of fact, it is hard to see how as much as 10,000 acres of rice can be grown in South Carolina at the present time, under prevailing conditions.

The industry is moribund and ought to have been dead for the sake of decency long ago, as it merely perpetuates conditions the world has outgrown.

Louisiana and Texas, with white labor, ought to make money with rice selling at 50 cents a bushel; we could not make a cent with rice at $2 a bushel. A little examination would show you why.

For an example that will be illuminating, take the case of Georgetown, formerly the center of the rice industry. Oysters are bought from Norfolk and fish from Tampa, although as the crow flies the town is eight miles from the marshes, abounding in both. Neither love nor money will move negroes to gather oysters or catch fish, except such fish as involves no manual labor in the catching, — flounders, shad, mullet and so on.

Surrounded by fifty miles of forest, wood cannot be bought at any price, except slabs from the saw mills. You will find these negroes working two days a week at the mills and loafing the rest of the time. That is why the planting of rice has failed. The rice-field task is three hours' work, beginning at 9 A.M. and ending at noon, sharp. Hoping against hope, a few planters have struggled on, but some have received the *coup de grace* this year, our amiable former governor, Mr. Heyward, being among the slain, for he lost $25,000 net this year. The bobolink ought to be welcome to what he can find in the rice fields, for if he can reap a profit there he exceeds man's efforts.

This correspondence suggests that the bobolink which is a useful bird in the north and also in the south in the cotton fields, where it destroys the cotton worm, should be protected throughout the country at all times, except when doing in-

jury in the rice field, and that the sale of the birds in the market should be stopped.

The decrease of bobolinks in New England has been noted almost universally, particularly in the coast region. Bobolinks are said to have been formerly very common on Nantucket during the breeding season, but they have disappeared. Many reports have been received of a decrease in bobolinks both on the coast and interior, but it was not until September, 1912, that an opportunity offered for a personal investigation of the matter in the South Atlantic States. At that time, on Sept. 3, 1912, Mr. Rice wrote that there had been a great falling off in the numbers of the bobolink in South Carolina within the past four or five years, due to slaughter, and abandonment of rice planting on the coast, and there would be no trouble in seeing the whole operation of the killing of birds, dressing them for the market and shipping them.

Early in September, 1912, I left Boston for Georgetown, S. C., and on arriving there found that the birds had not appeared in large numbers, that very little night killing was going on and that very few birds were being shot.

A trip was made to investigate the ravages of the fall army worm and the destruction of the pest by birds. Fields were seen where corn and cotton had been cut to the ground by the army worm until, finally, flocks of crows and blackbirds, especially red-winged blackbirds and grackles, had destroyed the army worms, saving the rest of the crop.

Later on another trip was made to Georgetown and the rice fields. At this time the rice was nearly harvested and the shooting and shipment of rice birds was at its height.

At the plantation of Mr. Charles Petigru Allston, about six miles out of Georgetown, the rice business was in its decadence. He was cultivating but a few acres where he formerly had great plantations. He said that upwards of twenty years ago the dealers sold the birds in all the large cities north and south and that some were shipped to Paris. Mr. Allston stated that planters in his township formerly bought about 500 kegs of powder annually to shoot at the

ricebirds, and that he, himself, personally, bought 75 kegs a year. Four or five bags of shot were bought, as it was necessary to kill a few birds to scare the others. Two out of four bags of shot, however, were buckshot which was hammered out of shape so that the shot would make a humming noise in the air and scare the birds. These buckshot killed very few birds. Mr. Allston at one time had 900 acres in rice fields and probably about 150 hands. His help and their families aggregated something over 400 people. He had very few birds shot because if the shot were used on the rice fields it would spoil the rice, and the shooters would tramp down the rice in picking up the dead birds. Now (1912), on looking over his rice field, there were so few birds that it would hardly pay to take the trouble of frightening them away.

Lest Mr. Allston's statement, regarding the powder used, might be deemed an exaggeration, we may refer here to the statement made by Captain Hazzard in the report of the Commissioner of Agriculture for 1886, page 249, in which he says, "During the bird season we employ about 100 bird-minders, who shoot from 3 to 5 kegs of powder daily, of 25 pounds each; add to this shot and caps and you will have some idea what these birds cost one planter."

Mr. J. Henry Donaldson, who has charge of some of the largest rice fields, stated that no one else in his vicinity was planting much rice now, and practically all the birds came to his fields. On September 20, upon my arrival in the fields, a good part of the rice was cut. Mr. Donaldson said that shooters on his fields were all shooting for market and not to protect the rice, and that such shooting as they did was little protection, as each gunner would wait until he could get a large number of birds at one shot, and meanwhile the birds had a good opportunity to feed. He formerly hired bird-minders, but did not let them shoot many birds.

On my arrival at the rice fields, colored gunners were seen in all directions, and the popping of guns was continual. All the shooting appeared to be done by creeping up to birds when they were sitting on stubble or on the heaped-up rice, select-

ing a time when a large number flocked together. One of the negroes said that he often frightened up the birds in the rice fields and shot into the flocks as they flew, but I saw nothing like this. One man with a full bag told me that he had 8 dozen birds at noon and that he killed 16 dozen the day before. Another stated that he had 6 dozen so far, and shot about 12 or 13 dozen daily on an average, but that formerly he used to get 14 or 15 dozen, or even more, when the birds were numerous. He said it was not unusual formerly to kill 20 to 30 dozen at night, and sometimes even 40 dozen, but all the negroes that I talked with agreed that they were getting very few at night now. Some said that nights must be dark for successful hunting. They said that they received 20 cents a dozen now for "shoot" birds and 25 to 30 cents for "ketch" birds. One gunner said that when he could not get 25 cents a dozen he would knock off.

Canals bordered on both sides by dikes enter the rice fields from the river. Here and there on the dikes are patches of small cane, and the banks are lined with flags, reeds, rushes and other water plants. Ditches run around each field about a rod from the dike. A negro shoots sometimes from the cover of vegetation on the dike, but usually approaches the birds crouchingly over the marshes. Some use muzzle-loading guns, others breechloaders, buying their shells loaded. At noon a dozen men and boys were counting up their forenoon's bag on a dike, and if their count can be relied upon, they had about 1,000 birds. Every man but one that I saw had a gun and was shooting birds. This one was carrying a tin pail and was a rice harvester. He said that rice harvesting paid better than shooting ricebirds. Sometimes he said the gunners did not get any ricebirds at all. He said he never had had a gun or shot birds in his life. Another stated that he had been shooting since he was ten years old. He shoots ducks in the rivers, birds in the marsh, and anything that can be sold or used for food. The man who did not shoot had a long whip with a short, wooden handle and a lash about 15 feet long made of old rope. He said that this would scare the birds more than a gun. He picked it up,

and, whirling the long lash around his head, yelled with full volume of his lungs and cracked the whip; it sounded somewhat like a rifle shot. Mr. Donaldson stated that when the birds get accustomed to the sound of the shotguns, the crack of the whip, being an unusual sound, frightens them more than the gun.

My inquiries at the markets of Georgetown, regarding the shipments of bobolinks, corroborated the statement made by Mr. Rice to the effect that the traffic had fallen off greatly. Those markets which formerly furnished the greater part of the supply were doing very little business. On the Back River, however, a firm was found which had established quarters in a scow, roofed over, in which about 14 women and children were engaged in picking the birds, and here the hunters came in with their "game." Each negro "picker" plucked the feathers from the birds and arranged them, when plucked, in rows of a dozen each, when they were packed in small baskets by the white man having charge of the business.

While it is probable that some birds have been killed to protect the rice crop in the past, it seems quite evident now that the killing is done for the price which the birds bring in the market, and the trade is fostered by the marketmen who make a profit in selling the birds. The marketing of ricebirds should be stopped. The rice business has nearly disappeared from the Atlantic coast region, partly because of the "help" problem and partly because of severe storms which have laid waste the rice fields, also because of the competition in Arkansas and Texas where rice can be grown by irrigation upon comparatively dry lands and where machinery can be used in planting and harvesting the crops. All indications point to the probability that rice-growing in the South Atlantic States will soon be a thing of the past except such rice as is grown upon uplands for local consumption. The bobolink, therefore, should receive protection under the law everywhere in the United States except when injuring rice crops. Thus far there has been no complaint of bobolinks in Texas and Arkansas, and in their route of migration they

Scow on the Back River at Georgetown, S. C , used for picking and packing bobolinks (rice birds). (Photograph by E. H. Forbush, September, 1912.)

Interior of scow. Negro women and children plucking bobolinks for the market. (Photograph by E. H. Forbush at Georgetown, S. C., September, 1912.)

seem to have avoided these rice-growing regions and have drifted along the Atlantic coast.

The people shipping bobolinks were very chary about volunteering any information, and it was impossible to get any statistics of the number of birds shipped. Every one agreed, however, that there were not nearly so many birds as formerly. Nevertheless, the quantity of birds shipped must have been large, as numbers of gunners were coming every morning with them and the pickers were very busy.

During my travels about South Carolina, between Georgetown and the region below Charleston, many people acquainted with the conditions regarding birds and bird killing were seen, and all agreed that most of the negroes were now armed with guns and that many were shooting small birds, and that many of the birds had decreased in number. This shooting was not by any means confined to small birds, as the destruction of wild fowl and game birds was distressing. Many of the colored boys had air guns and with them shot small birds of all kinds. I observed this personally and was informed of it by the citizens.

In conversation with old residents it was learned that just before and after the civil war birds were very plentiful. No one did any shooting except a few gentlemen sportsmen who had guns, and the negroes were not provided with firearms; but since the war negroes have secured cheap firearms and have decimated the game and birds in many localities and over large areas. In South Carolina, for two years there has been no appropriation for the chief game warden, and conditions are very bad. The only immediate remedy for such conditions is the enactment of a federal law, protecting migratory birds.

Wild Fowl wintering in Increasing Numbers.

Many reports have been received of an increase in the number of wild fowl wintering in Massachusetts since a law was passed in 1909, prohibiting the killing of wild fowl from December 31 to September 15 annually. This increase has been attributed by many people to this statute, but others

have contended that the accession in the numbers of wild fowl wintering here was due not to the protection of the law, but to the mild winters. The winter of 1911–12, though mild in its early part, was very severe after January 1, when the close season begins. Notwithstanding the severity of the winter, it was evident that the number of birds wintering with us had increased.

Mr. Chauncy C. Nash of Boston stated on Feb. 17, 1912, that he had found by experience that since the law went into effect many more ducks remain with us than formerly, and that also in the spring they are seen in much larger numbers. His observations have been made on the north and south shores and on Cape Cod. During the past winter at South Yarmouth he says there were 3,000 brant and many ducks in spite of the severe weather. The natives there state that there have been more seen there this season than for many years, and during the extremely cold weather many birds, especially the brant, were seen feeding at times in the open spaces of the Bass River near the town. This tameness was observed at many places in the State. Mr. Allan Keniston states that sheldrakes, whistlers and bluebills were feeding around the docks in the harbor of Edgartown, and Dr. George W. Field, chairman of the Fish and Game Commission, was able to take many photographs of wild fowl from the shore and from the docks. When the ice broke up considerable numbers of sheldrakes and other waterfowl came into Boston harbor and up the Charles River.

Wild Fowl starving in the Hard Winter of 1911–12.

In February, 1912, after a long spell of very cold weather, articles appeared in the newspapers to the effect that large numbers of wild fowl along the Massachusetts coast were dying from cold and starvation. This was said to be particularly the case around Nantucket and Marthas Vineyard, where the shoals were covered with ice and where the ducks could find very little food. The Fish and Game Commissioners investigated these stories and found that many birds were in a starving condition and apparently a few had died.

I endeavored to get some of the dead birds, but was able to secure but one which had actually died of starvation. Undoubtedly, however, there were others. Mr. Allan Keniston wrote me from Edgartown that he had seen the remains of a few ducks on the ice, but that the starving crows attacked them as soon as they were dead, stripping the flesh from their bones, so that it was impossible often to determine the cause of their death. It is quite probable that the cold actually killed some of the starving and weakened ducks. In my inquiry I endeavored to learn whether a similar condition was known elsewhere. Mr. Wilbur F. Smith, County Game Warden of Fairfield County, Conn., wrote that the ice along the coast of Long Island Sound was very heavy and long-continued, and that the black ducks suffered severely. As they sat around on the ice waiting for it to break up, many of them starved and froze to death. He stated that at the mouth of the Housatonic River the ice was solidly frozen for the first time in the memory of the inhabitants, but opposite Milford point, inside the mouth, an open space remained where the current is very strong, and there the ducks from all about congregated to feed. It was estimated that there were nearly 10,000 birds, mostly broadbills with a lesser number of black ducks. There were only a few places where the black ducks could feed, and they apparently soon used up the food supply and began to crawl in under the rocks of the breakwater in their hunt for food. He believes that at the time the ice broke there were large numbers of black ducks that were so near starvation that had the ice lasted one week longer they would have died of hunger, as they hardly had strength enough to get out of the water. He found 46 black ducks, 3 broadbills, 1 mallard and 1 "apparently a female pintail" which, he believes, starved or froze to death. He believes that it was fortunate for the birds that hunting was not permitted in the winter months, as in that case many of the birds would have been slaughtered and hundreds of others driven out on the ice to starve to death. This is the only case where I have been able to secure positive information that any considerable number of ducks had starved, but

had the ice embargo continued longer on the New England coast the result might have been very serious. It seems evident from all that can now be learned that wild fowl remain on the coasts of Connecticut and Massachusetts (where they are protected) in spite of severe weather rather than go farther south and expose themselves to the attacks of the hunter. No such increase of ducks in winter as has been noted here in the last two years has been reported from the States immediately to the south of New England.

Respectfully submitted,

EDWARD HOWE FORBUSH,
State Ornithologist.

THIRD ANNUAL REPORT

OF THE

STATE INSPECTOR OF APIARIES.

PRESENTED TO THE BOARD AND ACCEPTED,
JANUARY 7, 1913.

THIRD ANNUAL REPORT OF THE INSPECTOR OF APIARIES.

To the State Board of Agriculture.

I respectfully present the third annual report of the State Inspector of Apiaries for the year 1912.

The current year for beekeepers has been materially better than the two preceding. Colonies have responded more quickly to treatment than previously. There has been, as might be expected, a reduction in the general prevalence of disease. A few new outbreaks were discovered. Some of the territory previously visited it was impossible to revisit this year, in an effort promised the beekeepers to penetrate new territory. It was found necessary to quarantine slightly over half as many apiaries as during the previous year, disease being found in 144 apiaries against 234 in 1911. This speaks well for the improved conditions. A larger number of apiaries were under observation, the total being 1,596. Those receiving a second visit numbered 195, so that the total number of visits to apiaries amounts to 1,791.

Improved Conditions in the Apiaries. — As an index of the improvement which is general among thrifty beekeepers, the apiary illustrated in the first annual report may be cited as an example of what can easily be accomplished with a little pains. This apiary in the spring of 1910 contained 8 colonies, 7 of which had American foul brood. These were successfully treated and used as a demonstration to neighboring beekeepers. On visiting this same apiary in August, 1912, it was found to have increased materially. Some colonies have been sold, and there remain 20 colonies of superior bees in a fine state of health. The apiarist, besides increasing his stock this year and without special effort, took approximately one-quarter of a ton of honey. It should be

remembered that this apiary is in a town in which practically every colony of bees was found diseased, and in which both American foul brood and European foul brood prevailed.

The practice of demonstrating to beekeepers has been continued in accordance with the keynote of apiary inspection in Massachusetts, which from the first has been *education*. The fruits of the effort are appearing; not infrequently the inspectors find that beekeepers have already treated a sporadic case of disease before the inspector arrives. This is a vast improvement over conditions at the outset, when beekeepers did not know that they had foul brood. Now many are able to recognize disease and then distinguish which type they have met with. It should be said at this point, too, that the re-occurrence of disease is usually slight and gains no headway with beekeepers who have become familiar with handling it.

Prevalent Diseases of the Year. — The infectious disease most apparent during the current year was European foul brood, which was about four times as prevalent as American foul brood. The inspectors have also noticed an unusual prevalence of pickled brood, and the writer's personal observation was that it occurred to an injurious extent occasionally.

Winter Loss. — In 1905 beekeepers sustained a severe winter loss, which, according to many was exceeded during the winter of 1911 and 1912. Careful records of the winter loss were taken in order to ascertain the percentage. Among 756 beekeepers who could furnish data in all parts of the State, there were put into winter quarters 5,199 colonies of bees, 2,080 of which succumbed during the winter. This is approximately 40 per cent of the colonies on record. It was repeatedly observed that some small apiaries succumbed entirely. In other cases the loss was from 50 to 60 per cent. Many a beekeeper had but few colonies to start his apiary in the spring. The reasons for this considerable loss were largely due to the severity of the winter and the hardships of the previous season. The 40 per cent. loss for Mas-

sachusetts is probably quite as close an estimate as is available for other sections of the country. There was a very heavy depreciation of stock throughout the country east of the Mississippi River.

Increase in Beekeepers. — The records of the office show that there have been but few beekeepers who commenced in 1912, 22 being recorded with 14 additional prospective beekeepers. A far greater number were stricken from our list as having discontinued beekeeping. Two hundred and ninety-seven records were discontinued in the files. Some of these, however, unknown to the office, had discontinued previous to this year.

Miscellaneous Work.

Correspondence. — A proportionate increase in the correspondence has occurred in the present year. A low estimate places it at 33⅓ per cent increase over 1911. The interest without New England is increasing. It has been necessary to secure additional assistance in order to keep up with this phase of the work and to attend to certain details of the records which are explained elsewhere.

Records. — The satisfaction of the record system on cards is evident from the fact that no alteration for the next year is found necessary.

A very prominent feature of the success of the season, however, is due to the adoption of the so-called "clean-up" card.

"Clean-up" card. — The policy of inspectors, as brought out at the Convention of Apiary Inspectors, held at Amherst in 1912, whose proceedings are appended, show that it is not deemed advisable in many States to revisit apiaries. The energy thus consumed, it is considered, is better spent if applied to new territory, or by following up urgent or unusual cases. A compromise has been attempted in Massachusetts. In order to notify the office that the instructions of the inspectors have been fulfilled, the card illustrated below has been adopted.

The Commonwealth of Massachusetts No.

APIARY INSPECTION — STATE BOARD OF AGRICULTURE.

This card is signed by the beekeeper and retained by the inspector for file.

County————————

————————19— Town————————

My apiary has been {examined / quarantined} by the Inspector, who directs me to {clean up the apiary / treat all designated and diseased colonies,} according to his instructions, which I will do before————————, reporting it to the Inspector of Apiaries on the card provided.

————————————————

Owner or Person in Charge.

(Daily report to be used in "clean up" and "quarantine" cases.)

Detach here. - - - - - - - - - - - - - - - - -

No.

REPORT OF OWNER. To be returned on or before————————

Reverse side: post card addressed to office of Inspector of Apiaries.

To the Inspector of Apiaries,

Amherst, Mass.

Dear Sir: —

I am pleased to report that this day I have completed the treatment of all diseased colonies, have cleaned up my apiary, as instructed by the Inspector of Apiaries. Signed————————————————

Date————————19—

INFORMATION: — All diseased colonies are to be treated promptly, the infected materials immediately disposed of, destroyed or burned, according to the directions of the Inspector.

In any apiary, ALL REFUSE, including hives, frames, sections, quilts, combs, and honey exposed about the premises are to be removed to safety from bees AT ONCE. Prevent ROBBING at all times, remembering that HONEY is the common agent of infection. Further information may be had from the address on the reverse of this card.

Owners will sign and mail the above statement. [SEE OVER.]

Report card serving double purpose: a Daily Report from the inspector to the home office and a report from the beekeeper that instructions have been complied with. (Author's original illustration.)

Its further use is also to provide a means of ascertaining without a second visit that apiaries not infected but dangerously ill-kept, or otherwise dangerous to the welfare of neighbor beekeepers, are cleaned up and placed in sanitary condition. By striking out certain words on the card, the report is made to read that the instructions for cleaning up have been fulfilled. During the past year upward of 500

have been used. In very few instances did the reports fail. In the case where a beekeeper failed to report on time, a letter was sent to him asking the reasons for delay. The card is used not only in the case of improving the sanitary conditions of the yard, but also as a report upon completing the treatment of bee disease. Where a beekeeper found it necessary, by cause of accident or other reason, to ask for an extension of time, this has been granted freely at the discretion of the inspector.

Publications. — Bulletin No. 5 of the "Apiary Inspection" series has been issued with an edition of 1,500 copies. The report of the inspector for 1911 constitutes Bulletin No. 4 of the same series.

Resignations. — The inopportune and unfortunate resignation of Mr. William H. Thatcher resulted in the inadvisability of filling the vacancy during the current year. It is highly recommended, however, that Mr. John Shaughnessy of South Lee be appointed Deputy Apiary Inspector to fill the vacancy caused by Mr. Thatcher's resignation.

Attendance at Meetings. — Among the important meetings of the year, was the Convention of Apiary Inspectors of the northeastern United States and Canada, held at Amherst Feb. 7 and 8, 1912, and referred to elsewhere. This is the meeting which was proposed in the report of 1911. The convention has proven of a decided benefit to the Massachusetts service. As is usual, the writer has attended numerous other beekeepers' conventions for the purpose of delivering addresses. Record of this attendance is kept on file.

Meeting of the Apiary Inspectors of the Northeastern United States and Canada.

For improving the efficiency of the Massachusetts inspection service, as well as making an effort to co-ordinate the inspection work of the several States, and to co-operate to a greater extent with inspectors of the adjacent States, a conference of apiary inspectors in Amherst was proposed in the last report. This met with general favor and the meeting was held on February 7 and 8. Those present were: —

Prof. W. C. O'Kane, entomologist, New Hampshire.
J. P. Rock, inspector, Vermont.
A. C. Miller, inspector, Rhode Island.
Dr. W. E. Britton, State Entomologist, Connecticut.
H. W. Coley, inspector, Connecticut.
A. W. Yates, inspector, Connecticut.
W. D. Wright, agent, New York.
Dr. E. F. Phillips, in charge of apiculture, Bureau of Entomology, Washington, D. C.
Dr. B. N. Gates, inspector, Massachusetts (*presiding*).
J. L. Byard, deputy inspector, Massachusetts.
I. W. Davis, deputy inspector, Massachusetts.
W. H. Thatcher, deputy inspector, Massachusetts.

Besides the discussion of methods and purposes presented in the papers which are appended as the proceedings of this convention, a noticeable feature of the meeting was the inspiring of greater interest and enthusiasm in apiary inspection work, and the need for such service in the New England States where the work is not yet provided for. New Hampshire, represented by Professor O'Kane, has manifested intention to secure inspection service.

Abridged proceedings are presented herewith as an appendix of the annual report of the inspector. It is respectfully recommended and earnestly urged that these proceedings be published and at once become available for the service of the inspectors of the United States, the Massachusetts Inspector having had numerous requests for a report.

The Organization of Beekeepers' Societies.

The beekeepers have proposed a union of the various local beekeepers' societies throughout the State. This is being accomplished. A provisional organization was arranged at a meeting on Sept. 14, 1912, held at Worcester. Those present were Mr. J. B. Levens, Malden; Mr. O. F. Fuller, Blackstone; Mr. J. L. Byard, Marlborough; A. A. Byard, West Chesterfield, N. H.; Mr. Arthur Monroe, Spencer. A joint meeting for perfecting the organization will be held with the Worcester County Beekeepers' Association on Feb. 8, 1913. The aim of this organization is to unify the interests of beekeepers, and serve as a medium of communication to the several local societies.

Two local beekeepers' associations have affiliated with the National Beekeepers' Association, namely, the Hampshire, Hampden, Franklin Beekeepers' Association and the Worcester County Beekeepers' Association. The desirability of this affiliation includes direct representation in the national body, the receipt of the monthly official organ of the association, the "Bee-Keepers' Review," together with the privileges of discount and the protection and promotion of beekeeping interests in their broadest sense.

Another body of special interest to inspectors is the provisional formation of an Association of Apiary Inspectors of the United States and Canada, which held a spontaneous meeting at Washington on Dec. 30, 1911, and which will meet for its first annual meeting in Cleveland in conjunction with the American Association for the Advancement of Science, Dec. 31, 1912. The Massachusetts State Inspector of Apiaries, who was elected Chairman, will preside. Dr. E. F. Phillips is secretary. The Association of Economic Entomologists are providing for the affiliation of the apiary inspectors.

In the vicinity of New Bedford the beekeepers are arranging for the formation of a society which will doubtless affiliate with the national and State organization.

FINANCIAL STATEMENT, NOV. 30, 1912.

Unexpended balance, appropriation of 1911,		$50 99
Deficiency appropriation,		235 21
Appropriation, 1912,		2,000 00
Services of inspectors,	$1,348 75	
Travel and necessary expenses of inspectors,	670 40	
Postage (December 2),	25 58	
Printing and stationery,	110 75	
Stenographic and clerical assistance,	91 53	
Telephone and sundries,	37 67	
Unexpended balance,	1 52	
	$2,286 20	$2,286 20

Respectfully submitted,

BURTON N. GATES,
State Inspector of Apiaries.

JAN. 8, 1913.

TWENTY-SECOND ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

PRESENTED TO THE BOARD AND ACCEPTED,
JANUARY 7, 1913.

Dairy Bureau—1912.

CHARLES M. GARDNER, Westfield, *Chairman.*
GEORGE W. TRULL, Tewksbury, P. O. Lowell, R. F. D.
OMER E. BRADWAY, Monson, Mass.

Secretary.

J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.

P. M. HARWOOD.

Address, Room 136, State House, Boston.

REPORT OF THE DAIRY BUREAU.

The police work of this department for the year 1912 has consisted of 8,028 inspections, resulting in 216 court cases and 216 convictions. One hundred and twenty-two of these prosecutions were for violation of the oleomargarine law, 88 for selling renovated butter in unmarked packages, and 6 for having in possession with intent to sell milk containing added water.

In the educational work the Bureau has provided several dairy institutes which were addressed by Dr. Charles E. North of New York City and others, with a view of informing the public of the modern rational method of securing clean milk by paying more for it. Twenty-eight addresses have been given by the general agent and others at dairy meetings during the year. Most of these lectures have been along the line of educating the consuming public to the true food value of milk, and the fairness of paying producers as much at least as the same nutrition costs in other foods of like origin, nutritive ratio and digestibility. The general agent upon invitation visited the plant of the New York Demonstration Company at Homer, and attended meetings of the national commission on milk standards both at Homer and New York City, also a conference of dairy interests at Albany, N. Y., to consider the national oleomargarine question. He has also prepared a bulletin on the food value of milk for the dissemination department of the State Board of Agriculture.

The Bureau has made its annual inspection of creameries, milk depots, etc., and has found as in previous years conditions gradually changing. Some creameries have gone out of business, some are on the verge of giving up, while others are increasing their output, in some cases materially. As in other lines of milk handling, there is of necessity continual adjustment to modern conditions.

THE DAIRY SITUATION.

The largest number of cows ever assessed in Massachusetts was 200,658, in 1890. The bovine tuberculosis campaign subsequently followed, with the result that in 1897 the number was reduced to 171,485. There was from this time on a gradual increase, with some fluctuations, until 1905 and 1906 when the number reached 181,920 and 181,816, respectively. Since then there has been a general decrease, with the result that on April 1, 1912, the number was 161,608. Massachusetts is but one of a score of States where the number of cows has recently decreased. This condition, while alarming on the face of it, is not without compensation. From the very outset milk has been mainly produced as a by-product of general farming. Milk production for the general market has rarely stood upon a strictly independent paying basis. It is generally acknowledged that a given amount of nutrition in the form of milk has for years sold for a lower figure than that in other animal food products of similar nutritive ratio and digestibility. The natural result of this condition, added to the fact that our railroad laws are such as allow discrimination in favor of out-of-State milk, is that in those sections which have been shipping milk to the Boston market many have found the unprofitableness of the business too great to stand, and have, therefore, sold their herds. The production and marketing of clean milk, rich in solids, and bringing a price above that of general market milk, is the hope of the Massachusetts farmer so far as the Boston supply is concerned, and is what the most progressive farmers are striving for in all localities. With the growth of our cities and towns this near-by fresh milk is, and will be, more and more needed and used. The number of cows will cease decreasing only when that time arrives (in the not far distant future) when a sound business basis for dairying is established in this Commonwealth, — the condition most desired. Meanwhile, pasteurized milk and reduced milk in its various forms will continue to come from outside sources. But like counterfeit butter, which never reaches the quality of the best creamery product, this class of milk can never equal the pure, clean, raw, near-by product of the local dairymen. It is gratifying to know that the demand for locally produced milk,

at a price ranging from 1 to 2 cents per quart above that obtained for average market milk, is on the increase, and is being met each year by more farmers entering into its production. Elsewhere in this report will be found a list of farms making milk of this class as well as a list of those making certified milk in Massachusetts. It is hoped that by the end of another year many more farmers, so entitled, will be added to this list.

Milk Consumption.

For the first time since 1906 we are able to report a gain in the apparent consumption of fluid milk in Greater Boston. This is a good omen and indicative that the end of the scare crusade against milk is at hand. The milk question is being treated with more and more fairness by both the scientific world and the press. The pasteurization of general market milk (and some other milks) has probably been another factor in restoring confidence and arresting the declining use of this most desirable food product.

Price of Milk.

The retail price of general market milk now varies in this State from 7 to 10 cents per quart, according to locality and conditions. Milk of superior quality and cleanliness, including inspected milk, sells for from 9 to 12 cents (in a few instances higher) per quart, and certified milk from 12 to 18 cents per quart. There has been thus far but small demand for certified milk in Massachusetts.

Condensed Milk.

In another part of this report there will be found figures showing the amount of wholesale trade in condensed and evaporated milk from Boston. As this is the first year any record of these goods has been kept no exact comparisons can be made. We are inclined to believe, however, that the increase of trade in condensed milk is not as great as occurred in the preceding two or three years.

Local Milk Inspectors.

During the last few years a large number of local milk inspectors with splendidly equipped laboratories have been established in the various cities and towns in this Commonwealth. They are appointed by and are under the control of local boards of health. The character and ability of these men is noteworthy, and the work they are doing is highly creditable to the State. A complete list of these inspectors may be found in another part of this report.

Oleomargarine.

The number of retail oleomargarine licenses in force in this State November, 1911, was 459, while in 1912 it was 846, showing an increase of 387. Oleomargarine receipts in Boston, as reported by the Chamber of Commerce in 1911, was 104,685 packages, while in 1912 it was 140,040, showing an increase of 35,355 packages. Oleomargarine produced in the United States in 1911 was 121,162,795 pounds, while in 1912 it was 128,601,053 pounds, showing an increase of 7,438,258 pounds. This increase in the manufacture and sale of oleomargarine is probably due to the high price of butter which has prevailed throughout the year.

So far as our agents have been able to discover no attempts to sell artificially colored oleomargarine have been made. For further details see tables on page 248.

Renovated Butter.

In 1911 there were 39,292,591 pounds of renovated butter produced in the United States, while in 1912 there were 46,387,398 pounds, showing an increase of 7,094,807 in twelve months, an increase also due to the prevailing high price of butter. See table on page 249.

Butter.

The annual statement of the Chamber of Commerce shows an increase in the consumption of butter during 1912 of but 398,597 pounds, figures much below the average increase and due undoubtedly to the average wholesale price of 31.2 cents per pound, the highest on record by at least 1 cent per pound. Details will be found in tables on pages 249–250.

LEGISLATION.

Last year this Bureau introduced a bill in the Legislature modifying the condensed milk law which was enacted in accordance with the suggestions offered. This year we find that the Bureau has reached the point where more money is needed to carry on its police and office work and to add to its efficiency in endeavoring to secure more satisfactory dairy conditions in Massachusetts. We therefore ask that section 12 of chapter 89 of the Revised Laws, as amended by chapter 416 of the Acts of 1908, be amended by striking out the word "eight" in the first line, and inserting in place thereof the word "ten", so that said section shall read as follows: —

SECTION 12. The bureau may expend not more than ten thousand dollars annually in its work, and it may co-operate with the state board of health and with inspectors of milk, but it shall not interfere with the duties of such board or officers. It shall annually, before the fifteenth day of January, report to the general court in detail the number of agents, assistants, experts and chemists employed by it, with their expenses and disbursements, of all investigations made by it, of all cases prosecuted with the results thereof, and other information advantageous to the dairy industry.

Also that section 2 of said chapter 416 be amended by striking out the word "eight" in the first line, and inserting in place thereof the word "ten", so that said section shall read as follows: —

SECTION 2. The said sum of ten thousand dollars shall be allowed from the first day of December, nineteen hundred and twelve.

PERSONNEL OF THE BUREAU.

The personnel of the Bureau is as follows: Charles M. Gardner of Westfield, chairman, George W. Trull of Tewksbury and Omer E. Bradway of Monson. The executive force, agents, chemists, etc., are as follows: executive officer and secretary, J. Lewis Ellsworth; general agent, P. M. Harwood; B. F. Davenport, M.D., of Boston, and F. W. Farrell of the Emerson Laboratory, Springfield, have done the chemical work; A. W. Lombard has continued to act as agent, and five others have been temporarily employed.

Summary of Police Work.

Total number of inspections,	[1] 8,028
Number of inspections where no sample was taken,	5,968
Number of samples of butter, oleomargarine, and condensed milk, all purchased,	2,042
Number of samples of milk and cream,	124
Cases entered in court,	216
Addresses by general agent and others,	28

Cases prosecuted during the twelve months ending Nov. 30, 1912, by months and courts, with law violated, and results, are as follows: —

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Haverhill, Northern Essex District.	December,	1	1 milk,	1	-
Lawrence Police,	December,	2	2 renovated butter,	2	-
New Bedford, Third Bristol District.	December,	6	6 oleomargarine,	6	-
Newton Police,	December,	1	1 renovated butter,	1	-
Fall River, Second Bristol District.	December,	4	2 renovated butter, 2 oleomargarine.	4	-
Lynn Police,	January,	13	4 oleomargarine, 9 renovated butter.	13	-
Peabody Police,	January,	2	2 oleomargarine,	2	-
Grafton, First Eastern Worcester District.	January,	1	1 milk,	1	-
Haverhill, Northern Essex District.	January,	35	12 oleomargarine, 23 renovated butter.	35	-
Hudson Police,	January,	1	1 oleomargarine,	1	-
Haverhill, Northern Essex District.	January,	4	2 renovated butter, 2 oleomargarine.	4	-
Worcester Central District,	January,	2	2 oleomargarine,	2	-
Lynn Police,	February,	8	8 oleomargarine,	8	-
Holyoke Police,	February,	6	4 renovated butter, 2 oleomargarine.	6	-
North Adams, Northern Berkshire District.	February,	20	10 oleomargarine, 10 renovated butter.	20	-
Pittsfield, Central Berkshire District.	February,	4	4 oleomargarine,	4	-
Clinton, Second Eastern Worcester District.	March,	4	2 renovated butter, 2 oleomargarine.	4	-
Southbridge, First Southern Worcester District.	March,	1	1 milk,	1	-
Somerville Police,	March,	2	2 oleomargarine,	2	-
Boston Municipal,	March,	2	2 oleomargarine,	2	-
East Boston District,	March,	4	4 renovated butter,	4	-
Boston Municipal,	March,	3	1 renovated butter, 2 oleomargarine.	3	-
Charlestown District Municipal.	March,	2	2 oleomargarine,	2	-
Boston Municipal,	March,	2	2 renovated butter,	2	-
Worcester Central District,	April,	2	2 oleomargarine,	2	-

[1] There were 106 extra samples taken during the year, therefore this number is less than the sum of the next three items.

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Lowell Police, . . .	April, . .	31	9 renovated butter, 22 oleomargarine.	31	-
Gloucester, Eastern Essex District.	April, . .	10	10 oleomargarine, .	10	-
Salem, First Essex District,	April, . .	2	2 oleomargarine, .	2	-
Salem, First Essex District,	April, . .	2	2 oleomargarine, .	2	-
South Boston District Municipal.	April, . .	7	1 oleomargarine, 6 renovated butter.	7	-
Springfield Police, . .	June, . .	1	1 milk, . . .	1	-
New Bedford, Third Bristol District.	June, . .	4	4 renovated butter,	4	-
Gloucester, Eastern Essex District.	June, . .	2	2 renovated butter,	2	-
Lawrence Police, . . .	June, . .	10	8 oleomargarine, 2 renovated butter.	10	-
Lowell Police, . . .	July, . .	1	1 oleomargarine, .	1	-
Springfield Police, . .	August, .	1	1 milk, . . .	1	-
Gardner, First Northern Worcester District.	August, .	1	1 milk, . . .	1	-
Waltham, Second Eastern Middlesex District.	November, .	9	6 renovated butter, 3 oleomargarine.	9	-
Worcester, Central District,	November, .	2	2 renovated butter,	2	-
Northampton, Hampshire District.	November, .	1	1 milk, . . .	1	-

Note. — The Bureau is indebted to the milk inspectors of Massachusetts for assistance which has resulted in court cases.

The charges in the several cases entered in court for the year ending Nov. 30, 1912, have been as follows: —

Selling renovated butter in unmarked packages, ...	88
Selling oleomargarine without being registered, ...	2
Selling oleomargarine in unmarked[1] packages, ...	28
Furnishing oleomargarine in restaurants, etc., without notice to guests, ...	92
Selling milk containing added water, ...	6
	216

The following table shows the inspections without samples, and the number of samples taken during the past ten years: —

Years.	Inspections without Samples.	Samples.
1903–11 (inclusive), ...	45,714	12,409
1912, ...	5,968	2,166
Total for ten years, ...	51,682	14,575
Average, ...	5,168	1,458

[1] In these cases oleomargarine was sold when butter was asked for, but the charge was made in this way for convenience.

Tables relating to Oleomargarine.

The number of United States oleomargarine licenses in force in Massachusetts in November, 1911 and 1912 is as follows: —

	1911.	1912.
Wholesale licenses in Boston,	20	18
Wholesale licenses in other cities,	8	9
Total,	28	27
Retail licenses in Boston,	61	124
Retail licenses in other cities and towns,	398	722
Total,	459	846

The following figures, taken from the annual report of the United States Commissioner of Internal Revenue for 1912, show the production, withdrawn tax paid, and withdrawn for export of the two classes of oleomargarine, as defined by act of May 9, 1902, covering the period of ten years, since it went into effect on July 1, 1902: —

Oleomargarine (Pounds).

Year.	Product taxed at Rate of 10 Cents per Pound.			Product taxed at Rate of ¼ Cent per Pound.		
	Produced.	Withdrawn Tax paid.	Withdrawn for Export.	Produced.	Withdrawn Tax paid.	Withdrawn for Export.
1903,	5,710,407	2,312,493	3,334,969	67,573,689	66,785,796	151,693
1904,	3,785,670	1,297,068	2,504,940	46,413,972	46,397,984	123,425
1905,	5,560,304	3,121,640	2,405,763	46,427,032	46,223,691	137,670
1906,	4,888,986	2,503,095	2,422,320	50,545,914	50,536,466	78,750
1907,	7,758,529	5,009,094	2,695,276	63,608,246	63,303,016	129,350
1908,	7,452,800	4,982,029	2,522,188	74,072,800	73,916,869	109,480
1909,	5,710,301	3,275,968	2,403,742	86,572,514	86,221,310	112,958
1910,	6,176,991	3,416,286	2,767,195	135,685,289	135,159,429	97,575
1911,	5,830,995	2,764,971	3,054,344	115,331,800	115,448,006	91,750
1912,	6,235,639	3,174,331	3,044,122	122,365,414	121,945,038	106,160
Totals,	59,110,622	31,856,975	27,154,859	808,596,670	805,937,605	1,138,811

Table relating to Renovated Butter.

The following figures, from the same source as the preceding table, show the production and withdrawn tax paid of renovated butter, 1902–12: —

Renovated Butter (Pounds).

Year.	Production.	Withdrawn Tax paid.
1903,	54,658,790	54,223,234
1904,	54,171,183	54,204,478
1905,	60,029,421	60,171,504
1906,	53,549,900	53,361,088
1907,	62,965,613	63,078,504
1908,	50,479,489	50,411,446
1909,	47,345,361	47,402,382
1910,	47,433,575	47,378,446
1911,	39,292,591	39,352,445
1912,	46,387,398	46,413,895
Totals,	516,313,321	515,997,422

Tables relating to Butter.

The following table shows the average quotation for the best fresh creamery butter, in a strictly wholesale way, in the Boston market for the last ten years, as compiled by the Boston Chamber of Commerce: —

Month.	1912. Cents.	1911. Cents.	1910. Cents.	1909. Cents.	1908. Cents.	1907. Cents.	1906. Cents.	1905. Cents.	1904. Cents.	1903. Cents.
January,	36.9	28.8	33.5	30.9	29.7	30.4	25.2	28.0	22.7	28.0
February,	32.5	26.9	30.5	30.0	32.1	31.7	25.2	31.6	24.6	27.0
March,	32.1	24.2	32.0	29.1	30.2	30.2	25.5	28.0	24.1	27.0
April,	32.7	21.7	31.5	27.9	28.4	32.2	22.2	29.1	21.6	27.5
May,	30.4	22.8	29.0	26.6	24.1	31.4	19.9	23.9	19.9	22.5
June,	27.9	24.2	28.2	26.4	24.5	24.3	20.2	20.7	18.4	22.75
July,	28.1	26.0	28.6	27.2	23.6	25.9	21.0	20.6	18.3	20.5
August,	27.1	27.2	29.6	28.2	24.5	26.0	23.8	21.6	19.1	20.0
September,	29.1	27.7	29.6	31.3	25.3	29.2	25.6	21.2	20.8	22.0
October,	31.0	30.4	29.4	31.7	27.5	29.9	26.9	22.1	21.5	22.5
November,	32.9	32.5	30.2	31.4	29.5	27.1	27.6	23.0	24.1	23.5
December,	34.0	35.0	30.0	32.9	31.0	27 5	30.7	23.9	25.7	24.5
Averages,	31.2	27.3	30.2	29.5	27.5	28.8	24.48	24.47	21.73	23.97

The Chamber of Commerce figures regarding the butter business in Boston for 1911 and 1912 are as follows: —

	1912. Pounds.	1911. Pounds.
Carried over in storage,	6,612,966	12,272,624
Receipts for January,	3,282,660	2,058,615
February,	3,256,729	2,834,187
March,	3,565,555	3,290,750
April,	3,905,002	3,741,069
May,	7,003,321	6,070,694
June,	12,225,290	12,254,528
July,	13,030,718	8,282,768
August,	8,346,787	7,702,794
September,	6,051,810	6,288,939
October,	4,961,020	5,000,839
November,	3,717,156	3,329,460
December,	2,263,182	3,019,606
Total supply,	78,222,196	76,146,873
Exports for year, deduct,	24,005	74,446
Net supply,	78,198,191	76,072,427
Storage stock December 28, deduct,	8,340,132	6,612,966
Consumption for year,	69,858,059	69,459,461

Receipts of Condensed Milk.

The Chamber of Commerce figures regarding the receipts of condensed milk at Boston during 1912 are as follows: —

	Barrels.	Cases.[1]
January,	318	34,212
February,	174	32,066
March,	193	16,247
April,	375	20,614
May,	107	23,578
June,	187	27,080
July,	217	37,387
August,	146	44,461
September,	76	14,838
October,	262	22,240
November,	27	27,144
December,	222	22,079
Totals,	2,304	321,946

[1] Includes evaporated cream.

Milk.

Milk brought into Boston by Different Railroads, Dec. 1, 1911, to Nov. 30, 1912, as reported by the Railroad Commissioners (Quarts).

Date.	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.	Total.
1911.				
December,	957,011	5,684,134	1,681,167	8,322,312
1912.				
January,	699,099	5,640.697	1,746,433	8,086,229
February,	663,677	5,463,501	1,660,086	7,787,264
March,	778,999	5,959,732	1,798,682	8,537,413
April,	784,973	5,887,748	1,669,220	8,341,941
May,	999,002	5,926.088	1,609,096	8,534,186
June,	852,059	6,448,720	1,718,713	9,019,492
July,	1,323,508	6,389,101	1,468,410	9,181,019
August,	1,065,419	1,478,834	6,367,389	8,911,642
September,	1,044,702	6,622,503	1,446,076	9,113,281
October,	907,501	6,801,240	1,472,292	9,181,033
November,	1,114,468	6,534,098	1,354,856	9,003,422
Totals,	11,190,418	68 836,396	23,992,420	104,019,234

Receipts, 12 months ending Nov. 30, 1906, ... 114,233,976 quarts.
Receipts, 12 months ending Nov. 30, 1911, ... 90,092,772 quarts.

Comparative List of Number of Cows assessed in Massachusetts, May 1, 1906, and April 1, 1912.

Counties.	1906.	1912.	Decrease.	Increase.
Barnstable,	2,448	2,305	143	–
Berkshire,	17,404	16,463	941	–
Bristol,	13,702	13,552	150	–
Dukes,	656	583	73	–
Essex,	17,131	14,529	2,602	–
Franklin,	12,715	11,941	774	–
Hampden,	12,096	10,504	1,592	–
Hampshire,	14,383	12,261	2,122	–
Middlesex,	29,508	25,932	3,576	–
Nantucket	378	419	–	41
Norfolk,	11,200	10,095	1,105	–
Plymouth,	8,465	7,765	700	–
Suffolk,	1,186	1,015	171	–
Worcester,	40,544	34,244	6,300	–
Totals,	181,816	161,608	20,249	41

Net decrease, ... 20,208
Average net decrease per annum, ... 3,368

List of Massachusetts Farms making Milk of Superior Quality and Cleanliness and selling their Product higher than the Regular Market Price.

Location, Farm.	Owner, Manager.	Approximate Number of Cows.	Where marketed.
Agawam, Reilly Farm,	J. J. Reilly, owner and manager.	17	Springfield.[1]
Agawam, Colonial Farm,	H. E. Bodurtha, owner and manager.	10	Springfield.
Agawam, Elm Shade Dairy,	S. S. Bodurtha, owner and manager.	25	Springfield.
Agawam, Glen Farm,	W. H. Seaver, owner and manager.	12	Springfield.
Amherst,	H. M. Thomson, owner and manager.	30	Amherst.
Andover, Arden Farm,	Wm. M. Wood, J. M. Putnam, superintendent, Austin C. Huggins, manager of creamery.	[2]25 [3]30	Andover, Lawrence, Woburn and Boston.
Andover, Shattuck Farms,	F. Shattuck, owner and manager.	50	Lawrence.
Auburn, Keep & Sons' farm,	Keep & Sons, owners and managers.	30	Worcester.
Barre, Highland View Farm,	D. A. Howe, owner, G. E. Farnsworth, manager.	20	Worcester.
Bolton, Rocky Dundee Farm,	R. H. Randall, lessee and manager.	20	Clinton.
Brockton, Montello Station, Dutchland Farm.	Fred F. Field, Earl D. Upton.	70	Brockton.
Brookfield, Belding Farm,	W. C. Belding, owner, L. L. Belding, manager.	15	Springfield.
Caryville, Dudley B. Fowler's farm.	Dudley B. Fowler, owner and manager.	20	Boston, by C. Brigham Company.
Charles River, Walker-Gordon Farm.	Walker-Gordon Laboratory Company, owner, Charles H. Walker, manager.	100	Boston.
Chilmark, West Tisbury P. O., Oakview Farm.	J. F. Adams,	17	Vineyard Haven and Edgartown.
Cohasset, The Oaks Farm,	C. W. Barron, owner, W. E. Stilwell, manager.	83	Boston.
Dighton, Ralph Earle's farm,	Ralph Earle, owner and manager.	15	Fall River.[4]
Dorchester, Codman Farm,	Watson B. Fearing, owner and manager.	58	Boston.
East Lynn,	J. D. Coombs, lessee and manager.	3	East Lynn.
Fairhaven, Dana Farm,	Eliza N. Dana, Edith Dana.	45	Fairhaven, Marion and Mattapoisett (in summer).
Framingham, Millwood Farm,	Mrs. E. F. Bowditch, owner, J. P. Bowditch, manager, F. E. Barrett, superintendent.	190	Boston and Wellesley.
Franklin, Ray Farm,	E. K. Ray, estate, owner, Joseph G. Ray, trustee, manager.	100	Boston, by Elm Farm Company.
Gloucester, Howard P. Lane's farm.	Howard P. Lane, owner and manager.	50	Gloucester.
Gloucester, H. Wallace Lane's farm.	H. Wallace Lane, owner and manager.	30	Gloucester.
Gloucester, Peter Hadstrom's farm.	Peter Hadstrom, owner and manager.	6	Gloucester.
Grafton, D. E. Hallett's farm,	D. E. Hallett, owner and manager.	40	Boston, by C. Brigham Company.
Granby, C. W. Ball's farm,	C. W. Ball, owner and manager.	29	Holyoke.

[1] Several out-of-State farms also furnish milk of this class in Springfield.

[2] In Andover.

[3] In New Hampshire.

[4] Several Rhode Island farms also furnish milk of this class in Fall River.

List of Massachusetts Farms making Milk of Superior Quality and Cleanliness and selling their Product higher than the Regular Market Price — Continued.

LOCATION, FARM.	Owner, Manager.	Approximate Number of Cows.	Where marketed.
Greenfield, Wayside Farm,	Frank H. Reed, owner, Mr. Purrington, manager.	25	Greenfield.
Hamilton, Miles River Farm,	Maxwell Norman, owner and manager.	100	Boston.
Hardwick, Mixter Farm,	Mary A. Mixter, owner, Dr. Samuel J. Mixter, manager, S. R. Parker, Superintendent.	165	Boston.
Haverhill (Bradford District), Cedar Crest Farm.	C. Herbert Poor, owner and manager.	20	Haverhill.[1]
Haverhill, North Broadway Milk Farm.	E. A. Emerson, owner and manager.	35	Haverhill.
Haverhill (P. O. East Haverhill), Leonard H. Kimball's farm.	Leonard H. Kimball, owner and manager.	35	Haverhill.
Holliston, W. E. Marchant's farm.	W. E. Marchant, owner and manager.	12	Boston, by C. Brigham Company.
Holyoke, Whiting Farm,	W. F. Whiting, owner, John F. Richardson, manager.	20	Holyoke.
Longmeadow, Hillbrow Farm,	H. M. Burt, owner and manager.	20	Springfield.
Lowell, Hood Farm,	C. I. Hood, owner, J. E. Dodge, manager.	120	Lowell.
Ludlow, E. E. Chapman's farm,	Edward E. Chapman, owner and manager.	22	Ludlow and Indian Orchard.
Lunenburg, Sunnyside Farm,	Geo. M. Proctor, owner, Fred A. Miller, manager.	48	Fitchburg.
Marlborough, Fairview Farm,	Elmer D. Howe & Son, owners and managers.	40	Marlborough.
Medford, Hillside Farm, 20 Gow Street.	Alberton Harris, owner and manager.	10	Medford.
Medford, Mystic Valley Farm, 75 Arlington Street.	John J. Mulkevin, owner and manager.	16	Medford.
Methuen, Bragdon Farms,	E. L Bragdon, owner and manager.	30	Lawrence.
Methuen, Chestnut Grove Farm,	F. L. Gardner, owner and manager.	16	Lawrence.
Methuen, Cox Farms,	Louis Cox, owner, L. Coburn, manager.	31	Lawrence.
Methuen, Howe Farm,	E. D. Taylor, owner and manager.	50	Lawrence.
Methuen, Spring Valley Farms,	Fred Miller, owner and manager.	50	Lawrence.
Methuen, S. W. Williams' farm,	S. W. Williams, owner and manager.	30	Lawrence.
Millis, Lowland Farm,	E. F. Richardson, owner and manager.	25	Boston.
Milton, Highland Farm,	Ainslie Marshall, Wm. Middleton, herdsman.	65	Milton.
Norfolk, Meadowside Farm,	Walter F. Cook, F. A. Lougee.	35	Boston.
North Amherst, The Elms,	R. D. Dickinson, owner and manager.	30	Amherst.
Paxton, E. G. Richards' farm,	E. G. Richards, owner and manager.	40	Worcester, by C. Brigham Company.
Peabody, Maplehill Farm,	- -	-	Boston, by H. P. Hood & Sons.[2]
Pittsfield, Abby Lodge,	A. W. Cooley, owner, Mr. Carlson, manager.	14	Pittsfield.
Pittsfield, Mr. Bardwell's farm,	Mr. Bardwell, owner and manager.	14	Pittsfield.
Pittsfield, E. W. Page's farm,	E. W. Page, owner and manager.	8	Pittsfield.

[1] Two New Hampshire dairymen, Geo. B. Freeman and Herbert N. Sawyer, also sell milk of this class in Haverhill.

[2] H. P. Hood & Sons also distribute this class of milk from 10 farms in New Hampshire.

List of Massachusetts Farms making Milk of Superior Quality and Cleanliness and selling their Product higher than the Regular Market Price — Concluded.

LOCATION, FARM.	Owner, Manager.	Approximate Number of Cows.	Where marketed.
Reading, Elm Hill Farm, .	Allen C. Jones, owner and manager.	35	Boston.
Saugus, Oaklandale Farm, .	Frank P. Bennett, owner and manager.	50	Lynn.
South Lincoln, South Lincoln Dairy Company.	South Lincoln Dairy Company, owners, W. A. Blodgett, manager.	250	Boston.
South Natick, Carver Hill Farm,	Carver Hill Farms, Inc., Austin Potter.	75	Boston, Wellesley, Natick, Needham and Dover.
Sterling, Twin Oaks Farm (P. O. Pratt's Junction).	J. F. Pratt, owner, Geo. E. Pratt, manager.	75	Milk, Boston; cream, Worcester.
Stoughton, Tobey Farm, . .	E. B. Hutchins, owner and manager.	15	Brockton.
Taunton, Geo. Soper's farm,	George Soper, owner and manager.	30	Taunton.
Westwood, Fox Hill Farm, .	Joshua Crane, owner, L. W. Jackman, manager.	100	Boston.
West Newton and Barre, Wauwinet Farm.	Geo. H. Ellis, owner, P. F. Staples and R. M. Handy, managers.	400	Boston, Brookline and Newton.
Worcester, Pleasant View Farm,	Warren C. Jewett, owner and manager.	40	Worcester.
Worcester, ...	Lewis J. Kendall, owner and manager.	40	Worcester.
Worcester, Intervale Farm, .	J. Lewis Ellsworth, owner and manager.	14	Worcester.
Worcester, Village Farm, . .	H. B. Prentice, owner and manager.	30	Worcester.

NOTE. — Deerfoot Farm Dairy, office 9 Bosworth Place, Boston, with milk depots at both Southborough and Northborough, sells milk of superior quality and cleanliness at a price above that of ordinary market milk, and handles the product of 129 dairy farms, averaging about 10 cows each, located in Southborough, Northborough, Westborough and Holliston. Most of these farms, therefore, at some time during the year come properly within the requirements of this list. The method of payment of this milk is explained in the following extract from a letter from the proprietor, Mr. Robert M. Burnett: "The milk from all our farms is tested once or twice a week on delivery at the dairy, samples being taken by Professor Prescott's agent. When the milk is found to contain below 25,000 bacteria per cubic centimeter, and cows, feed, water and stable conditions are reported by Dr. J. W. Robinson as healthful and satisfactory, and the average test is not lower than 4½ per cent. butter fat, the price paid is 50 cents per can at the Deerfoot Dairy for the full yield all the year around. For any milk passing the above conditions, of good quality, testing below 4½ per cent. butter fat, we pay 45 cents per can for such proportion as we can bottle. For the balance of the milk not bottled, and for the milk from farms not meeting the conditions required for bottled milk, we pay the price agreed upon between the Milk Producers Association and the Contractors Union. For the month of December, 1912, this compact was with 129 farms averaging about 10 cows to the farm."

The foregoing list is necessarily incomplete owing to the fact that all returns had not been received at the close of the year.

List of Massachusetts Dairy Farms making Certified Milk.

Name, Location.	Owner, Manager.	Approximate Number of Cows.	Certified by —	Where marketed.
Cedar Hill Farm, Waltham.	Miss Cornelia Warren, Charles Cahill.	215	Cambridge Medical Commission.	Waltham, Cambridge, Boston.
Cedarcrest Farm, Waltham.	John C. Runkle, Louis W. Dean.	90	Cambridge Medical Commission.	North Shore, Cambridge, Brookline, Boston.
Ledyard Farm, Andover.	J. A. & W. H. Gould,	50	Malden Medical Commission.	Malden.
Massachusetts Agricultural College Farm, Amherst.[1]	Massachusetts Agricultural College Farm, J. A. Foord.	50	Suffolk District Medical Commission.	Boston.
Prospect Hill Farm, Essex.	J. A. & W. H. Gould,	175	Suffolk District Medical Commission.	Boston, Beverly.
"The Warelands," Highland Lake, Norfolk.[2]	Mrs. Charlotte B. Ware.	30	Suffolk District Medical Commission.	Boston.
W. C. White's Farm, Acushnet.	Walter C. White, .	28	New Bedford Medical Commission.	New Bedford.

[1] This milk is distributed by D. Whiting & Son.
[2] "The Warelands" was first in New England to produce certified milk.

Note. — H. P. Hood & Sons distribute certified milk from their Hood Farm, Derry, N. H.; also from Middlebrook Farm, owned by Miss Elizabeth C. Sawyer, Dover, N. H.

List of Local Milk Inspectors.

Milk Inspectors for Massachusetts Cities, 1912.

Beverly,	Henry E. Dodge, 2d.
Boston,	Prof. James O. Jordan.
Brockton,	George E. Bolling.
Cambridge,	Dr. W. A. Noonan.
Chelsea,	Dr. W. S. Walkley.
Chicopee,	C. J. O'Brien.
Everett,	E. Clarence Colby.
Fall River,	Henry Boisseau.
Fitchburg,	John F. Bresnahan.
Gloucester,	Dr. George E. Watson.
Haverhill,	C. Biscault.
Holyoke,	Daniel P. Hartnett.
Lawrence,	Dr. J. H. Tobin.
Lowell,	Melvin F. Master.
Lynn,	George A. Flanagan.
Malden,	J. A. Sandford.
Marlborough,	John J. Cassidy.
Medford,	Winslow Joyce.
Melrose,	Caleb W. Clark, M.D.
New Bedford,	Herbert B. Hamilton, D.V.S.

Newburyport,	Dr. R. D. Hamilton.
Newton,	Arthur Hudson.
North Adams,	Henry A. Tower.
Northampton,	George R. Turner.
Pittsfield,	Eugene L. Hannon.
Quincy,	Edward J. Murphy.
Salem,	John J. McGrath.
Somerville,	Herbert E. Bowman.
Springfield,	Stephen C. Downs.
Taunton,	Lewis I. Tucker.
Waltham,	Arthur E. Stone, M.D.
Woburn,	Edward P. Kelly, M.D.
Worcester,	Gustaf L. Berg.

Milk Inspectors for Massachusetts Towns, 1912.

Adams,	Dr. A. G. Potter.
Amesbury,	E. S. Worthen.
Andover,	Franklin H. Stacey.
Arlington,	Dr. L. L. Pierce.
Attleborough,	Caleb E. Parmenter.
Barnstable,	George T. Mecarta.
Belmont,	Prof. Samuel C. Prescott.
Brookline,	Frederick H. Osgood.
Clinton,	Gilman L. Chase.
Cohasset,	D. W. Gilbert, D.V.S.
Concord,	Erastus H. Smith.
Easthampton,	George L. McEvoy.
Gardner,	Clifford W. Shippee.
Greenfield,	George P. Moore.
Hudson,	Dr. A. L. Cundall.
Leominster,	William H. Dodge.
Ludlow,	A. L. Bennett, D.V.S.
Millbury,	Arthur A. Brown.
Milton,	W. C. Tucker.
Monson,	Dr. E. W. Capen.
North Attleborough,	Hugh Gaw, V.S.
Palmer,	Edward P. Brown.
Peabody,	H. S. Pomery, M.D.
Plainville,	John C. Eiden.
Reading,	C. H. Playden, M.D.
Revere,	Joseph E. Lamb.
Salisbury,	John H. Pike.
South Framingham,	Dr. J. H. McCann.
South Hadley Falls,	George F. Boudreau.
Spencer,	James A. Spencer.
Stoneham,	George H. Allen.

Wakefield,	Harry A. Simonds.
Ware,	Fred E. Marsh.
Watertown,	Luther W. Simonds.
Wellesley,	Cecil K. Blanchard.
Westfield,	William H. Porter.
West Springfield,	Norman T. Smith.
Williamstown,	G. S. Jordan, V.S.
Winchendon,	Dr. G. W. Stanbridge.
Winchester,	Morris Dineen.

Creameries, Milk Depots, etc.

Co-operative Creameries.

Number and Location.	Name.	Superintendent or Manager.
1. Ashfield,	Ashfield Creamery,	William Hunter, manager.
2. Belchertown,	Belchertown Creamery,	M. G. Ward, president.
3. Cummington,	Cummington Creamery,	D. C. Morey, superintendent.
4. Easthampton,	Hampton Creamery,	W. H. Wright, treasurer.
5. Egremont (P. O. Great Barrington).	Egremont Creamery,	E. G. Tyrell, manager.
6. Monterey,	Berkshire Hills Creamery,	F. A. Campbell, treasurer.
7. Shelburne,	Shelburne Creamery,	Ira Barnard, manager.
8. Westfield,	Wyben Springs Creamery,	C. H. Kelso, manager.

Proprietary Creameries.

Number and Location.	Name.	Owner or Manager.
1. Amherst,	Amherst Creamery Company,	R. W. Pease, manager.
2. Amherst,	Fort River Creamery,	Clarence M. Wood, manager (estate of E. A. King, owner).
3. Brimfield,	Crystal Brook Creamery,	F. N. Lawrence, proprietor.
4. Groton,	Lawrence Creamery,	Myron P. Swallow, manager.
5. Heath,	Cold Spring Creamery,	I. W. Stetson & Son.
6. Hinsdale,	Hinsdale Creamery,	Walter C. Solomon, proprietor.
7. Marlborough,	Este's Creamery,	F. F. Este, proprietor.

Educational.

Location.	Name.	Manager.
Amherst,	Dairy Industry Course, Massachusetts Agricultural College.	W. P. B. Lockwood, professor in charge.

Principal Milk-distributing Depots.

Name.	Location.	Manager.
Alden Brothers Company, Oak Grove Farm, Waumesit Farm.	Boston office, 1171 Tremont Street, depot, 24-28 Duncan Street.	Charles L. Alden, president, John Alden, treasurer.
Anderson Brothers, . .	Worcester, Eckman Street, . .	Anderson Bros.
Boston Condensed Milk Company.	Boston, 484 Rutherford Avenue, .	W. A. Graustein.
Brigham, C., Company, .	Cambridge, 158 Massachusetts Avenue.	John K. Whiting.
Brigham, C., Company, .	Worcester, 9 Howard Street, . .	C. Brigham Company.
Deerfoot Farms Dairy, .	Boston office, 9 Bosworth Street, depots at Northborough and Southborough.	S. H. Howes.
Elm Farm Milk Company,	Boston, Wales Place, . . .	James H. Knapp, treasurer.
Hood, H. P., & Sons,	Boston, 494 Rutherford Avenue; branches, 24 Anson Street, Forest Hills, 886 Broadway, Chelsea.	Charles H. Hood.
	Lynn, 193 Alley Street, . . .	
	Malden, 425 Main Street, . .	
	Watertown, 479 Pleasant Street, .	
	Lawrence, 629 Common Street, .	
Learned, G. S. (Fitchburg Creamery).	Fitchburg, 26 Cushing Street, .	G. S. Learned.
Newhall, J. A., . . .	Newburyport, 32 Munroe Street, .	J. A. Newhall.
Perry, A. D., . . .	Worcester, Kansas Street, . .	A. D. Perry.
Prentice, H. H., & Co. (Berkshire Creamery).	Pittsfield, Crane Avenue, . .	H. H. Prentice.
Somers Creamery Company,	Springfield, 178 Dwight Street, .	W. M. Cushman.
Springfield Creamery, .	Springfield, Main Street, . .	F. B. Allen, proprietor.
Tait Brothers, . . .	Springfield, 37 Vinton Street, .	Tait Brothers, proprietors.
Wachusett Creamery, .	Worcester, 6 Lincoln Street, . .	E. H. Thayer & Co., proprietors.
Whiting, D., & Sons, . .	Boston, 570 Rutherford Avenue, .	George Whiting.

Milk Laboratory.

Walker-Gordon Laboratory,	Boston, 793 Boylston Street, . .	George W. Franklin.

Receiving Depots for Milk, for Shipments to New York City.

The Borden Company of New York.	West Stockbridge, ...	Thomas Roberts.
Willow Brook Dairy Company.	Sheffield, ...	Frank Percy.

Expenses.

The following is a classified statement of the expenses for the year ending Nov. 30, 1912: —

Bureau: compensation and traveling expenses,	$609 61
Agents: compensation,	2,565 00
Agents: traveling expenses and samples purchased,	2,924 91
General agent: traveling and necessary expenses,	422 38
Chemists: analyses, tests, court attendance,	1,099 68
Printing and supplies,	289 03
Educational,	89 39
Total,	$8,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

CHARLES M. GARDNER.
GEORGE W. TRULL.
OMER E. BRADWAY.

NINTH ANNUAL REPORT

OF THE

STATE FORESTER.

A plantation of our native white pine at fifty-five years of age growing at Frankfort, Germany. We should have a large acreage like this in Massachusetts in the future. (Dr. M. Nausauer on the left, Oberforester Fleck on the right.) Taken by Massachusetts State Forester last summer.

NINTH ANNUAL REPORT OF THE STATE FORESTER.

Introduction.

The year of 1912 closes an extremely active season in the State Forester's department. Forestry work generally has met with enthusiastic support at the hands of our people, and it is a pleasure to serve in a public capacity under such favorable auspices.

We have a natural forest country and should take advantage of such a heritage. The renowned Black Forests of Germany show what can be accomplished by systematic methods, while in this country the State of New York has been farsighted enough to establish a forest preserve, the area of which approximates two-thirds the size of our whole State. I believe it is time that we people of Massachusetts should take steps to secure a forest preserve which might include, for example, the whole beautiful Berkshire country west of the Connecticut River, or our own renowned Cape Cod District. Either of these areas could readily be made into State reserves, and exploited under modern ideas of forestry management similar to the methods now proposed in the Adirondacks. At the present writing, individuals may destroy at their will the forest products, which will take time and great expense to replace. On the other hand, individual effort can accomplish a great deal, as a trip to Lenox and Stockbridge will testify, but of course quicker and greater results would come from State management of such lands. With a progressive policy a Berkshire forest reserve would ultimately outrival anything in Europe, as its location and topography are ideal.

Although good old Cape Cod is a different forestry proposition altogether, nevertheless its thousands of acres of depleted and waste lands were once covered with magnificent forest growth, and I believe they could be returned through State management, at small expense, to a sylvan condition which would not only be

a delight to the people of Massachusetts, but prove attractive to many from other States who summer with us. The light soils of the greater part of the Cape far surpass the sandy lands about Darmstadt, Germany, where there are flourishing forests. Our State highways are already proving that such an expenditure of State money pays, and it is believed that State supervision in forestry would prove equally beneficial. Forestry differs even from building State highways, in that forests neither wear out nor necessitate a constant maintenance expense, but, on the contrary, bring interest upon the investment and eventually enhance the principal itself.

On such a question, I believe I know where the various Massachusetts organizations, such as the State Board of Agriculture, the Massachusetts Forestry Association, the State Grange, Federation of Woman's Clubs, Fish and Game Associations, etc., would stand. We could rely upon their whole-hearted assistance.

When visiting the national forest near Brussels and while tramping through the Black Forests of Germany the past summer, I was charmed with their achievement, which appealed to me from both the economic and æsthetic standpoint. It was imperative that, on my return, I should try to enthuse the people of the old Bay State to greater endeavor by showing them what might be accomplished by solving the problem in a practical way.

Our people generally have grown to appreciate the great good that has been accomplished through establishing a State-wide forest fire protective system. With many lookout stations scattered over the whole State, from which vigilant, trained observers detect and report fires in their incipiency; with four district forest wardens who patrol their divisions and instruct and confer with the local forest wardens in their territory; with a corps of 300 rural mail carriers who travel 6,000 miles daily, except Sundays, with instruction to report all forest fires; and with improved equipment and better systematized organizations for fighting forest fires and determining their causes, we are launching out upon a new era of future possibilities in forestry in this State. Forest fires must absolutely be eliminated if we are to build a stanch, State-wide forest policy.

What is true of forest fires is equally true, only in another way, as to overcoming our forest insect and disease outbreaks. We

have been fighting the gypsy and brown-tail moths for years at great expense, — unwelcome guests, to say the least; but with improved methods and organized effort we were able to reduce the annual appropriation $65,000 the past season, and will recommend an additional reduction of $50,000 this year, making the amount asked for this year only $200,000, as compared with $315,000 ordinarily expended.

The chestnut bark disease is prevalent in the State, and the State Forester is lending every assistance possible in acquainting owners of chestnut growth with the latest methods of combating it. The national government is assisting us in our work against the chestnut bark disease. In a new country like ours it necessarily takes time to adopt and systematize our work so that it will result in future benefit to our people. Forestry and its future importance to the State is as yet relatively little appreciated, as it takes time to educate people generally to recognize its real value.

It is a pleasure to state that the last year's General Court gave the State Forester's department very generous consideration, and we have been enabled thereby to accomplish the work set forth in the following pages of this report.

The constitutional amendment relative to the taxation of forest lands has become a law, after having been submitted to the vote of the people at the recent election. The vote of the last General Court was practically unanimous, as there was not a dissenting vote in the Senate and scarcely any in the House, thus showing the popularity of the measure. It now remains for the incoming General Court to enact some practical, simple and effective legislation which will be sure to encourage modern forestry throughout the State. The State Forester does not wish it to be understood that he advocates the exemption of forest and waste lands from taxation. He believes that these lands should receive definitely regulated taxation, so that their owners may profitably allow the forest product to stand until mature.

The assistance by the State to towns having a million and a half or less valuation, for the purpose of having some permanent forest fire-fighting equipment, has been readily taken advantage of this year. The $5,000 allotted each year was exhausted early in the season, and we have requests already booked for next year.

Surveys and maps have finally been completed of all lands taken over by the State under the reforestation act. These are on file for future use.

The department has more nursery stock on hand than ever before, and a progressive policy has already been started with a view to reforesting all waste or worthless lands belonging to our State institutions. The policy is to furnish the stock for planting, free of charge, provided the institutions meet the expense of labor in setting them out.

The United States government, as was predicted last year, has agreed to take definite control of the problem of the spreading of the gypsy moth; hence hereafter our State work resolves itself down to internal self-preservation in the territory already infested. It behooves us, therefore, from now on to perfect and improve the conditions in our towns and cities. In order to accomplish this it must be self-evident that the man locally in charge must have sufficient training and ability to comprehend modern methods first, and in the second place have the ability to handle labor economically.

The assistance given citizens and institutions in suggesting and demonstrating methods of forest management has been greater than ever. The experiment of substituting runabout automobiles for motor cycles for division men who necessarily are constantly traveling has proved in some instances a great advantage.

There are other phases of the work that might be mentioned here, but they are to be more fully explained under their proper classification in this report.

Organization.

As is inevitably the case, there have been a few changes during the year in the personnel of the general staff of assistants, but we are fortunate in having intact the greater part of the same trusted and tried organization.

Mr. L. H. Worthley, who has been connected with this department as assistant in moth work for a number of years, resigned the fore part of the year to accept a similar position with the entomological division of the United States Department of Agriculture. The promotion was a well-deserved one, and after spending eight months in Europe with Mr. Fiske, the government

expert, studying the moths in their native haunts, he is now delegated to the duty of checking their spread from New England to other sections of the country. While the State of Massachusetts in a sense loses his services directly as a State employee, we feel assured that in his new position his services may prove of even greater value to us. Mr. George A. Smith, superintendent of District 1, was promoted to the position of assistant in charge of moth work. Mr. Smith has been connected with the work for a long time, and we are fortunate in having one so well qualified to fill this place.

Mr. R. M. Colley of Harvard University, who had charge of the work of propagating and disseminating the fungous disease of the brown-tail moth, completed his work this fall, and Mr. John Murdoch, Jr., a graduate of the Harvard Forestry School, who has been in the employ of this department during the past year, has been placed in charge.

Mr. F. F. Moon, who was associated with the State Forester as assistant during his connection with the Massachusetts Agricultural College, as professor of forestry, resigned to accept a professorship at Syracuse University. Mr. Clark, formerly of the State College of Pennsylvania, has been elected to succeed Professor Moon.

Mr. Wm. Reiff, a student of the Bussey Institute, who was temporarily engaged to carry on some experimental work on a large scale with the flascherie disease of the gypsy moth, under the general direction of Prof. W. M. Wheeler, resigned on August 1.

The organization of the State Forester's department at present is as follows: —

General Staff.

F. W. Rane, B.Agr., M.S.,	State Forester.
H. O. Cook, M.F.,	Assistant Forester.
M. C. Hutchins,	State Fire Warden.
George A. Smith,	Assistant, moth work.
R. S. Langdell,	Assistant, reforestation.
H. F. Gould, M.F.,	Assistant, forestry management.
W. D. Clark, M.F.,	Assistant, Massachusetts Agricultural College
R. H. Colley,	Assistant, moth disease work.
John Murdoch, Jr., M.F.,	Assistant, moth disease work.
Charles O. Bailey,	Secretary.
Elizabeth Hubbard,	Clerk, bookkeeper.
Charlotte Jacobs,	Clerk, mail and office.
Emilie Rau,	Stenographer.
Josepha L. Gallagher,	Clerk.
John Lanergan,	Office boy.

Co-operative Scientific Staff.

L. O. Howard, Ph.D.,	Chief, United States Bureau of Entomology, Washington, D. C., parasites and predaceous insects.
Theobald Smith, Ph.B., M.D.,	Professor of Comparative Pathology, Harvard University, diseases of insects.
Roland Thaxter, Ph.D.,	Professor of Cryptogamic Botany, Harvard University, fungous diseases affecting insects.
W. M. Wheeler, Ph.D.,	Professor of Entomology, Harvard University, experimental entomologist.

Staff, Forest Fire Protection.

F. W. Rane, M.S.,	State Forester.
M. C. Hutchins,	State Fire Warden.
M. E. Fenn,	Assistant.
James Moloy,	District Forest Warden No. 1.
J. J. Shepherd,	District Forest Warden No. 2.
John P. Crowe,	Distriet Forest Warden No. 3.
F. L. Haynes,	District Forest Warden No. 4.

Observers and Observation Stations.

District 1: —

Wm. Bray,	Bald Pate Hill, Georgetown.
Henry Fay,	Hart Hill, Wakefield.
J. Frank Hammond,	Robbins Hill, Chelmsford.
Elliot C. Harrington,	Blue Hill, Milton.
Alfred MacDonald,	Bluff Head, Sharon.

District 2: —

Calvin Benson,	Shoot Flying Hill, Barnstable.
Frank L. Buckingham,	Reservoir Hill, Plymouth.
Irving W. Chace,	Richmond Hill, Dighton.

District 3: —

J. Harry Allen,	Wachusett Mountain, Princeton.
Alfred W. Doubleday,	Lighthouse Hill, Prescott.
W. J. Halloran,	Fay Mountain, Westborough.
F. H. Lombard,	Grace Mountain, Warwick.
Geo. W. Sherman,	Steerage Rock Mountain, Brimfield.

District 4: —

Albert E. Bauer,	Greylock Mountain, Adams.
Edwin F. Desmond,	Becket Mountain, Becket.
Geo. C. Miller,	Mount Tom, Easthampton.
Nelson C. Woodward,	Massamet Mountain, Shelburne.

Staff, Moth Work.

F. W. Rane, M.S., . . . State Forester.
George A. Smith, . . . Assistant (General Superintendent).
Enwright, John W., Superintendent, District 1, 299 Fellsway, Medford.
Phillips, Saul, Superintendent, District 2, P. O. Box 266, Beverly.
Worthen, Francis C., Superintendent, District 3, Central Street, Georgetown.
Fitzgerald, John J., Superintendent, District 4, 50 Howard Street, Haverhill.
Hatch, William A., Superintendent, District 5, 174 Main Street, Hudson.
Ramsey, Harry B., Superintendent, District 6, 27 Lincoln Avenue, Worcester.
Parkhurst, Clarence W., Superintendent, District 7, P. O. Box 472, Medfield.
Holmes, Walter F., Superintendent, District 8, King Street, Cohasset.
Farley, John A., Superintendent, District 9, Plymouth, R. F. D.
Carleton, John F., Superintendent, District 10, East Sandwich.

Inspectors.

Armstrong, Henry F.
Emerson, Thomas.
Merrick, John L.
Sands, George A.
Silva, Joseph.

Mechanics.

Halpin, Frederick P.
Towle, Claude E.

Learoyd, Francis V., in charge, Supply Store.

List of Forest Wardens and Local Moth Superintendents.

[Alpabetically by towns and cities.]

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
No telephone, .	B. E. Wilkes,[1] . . .	**Abington**, . .	C. F. Shaw, . .	9
No telephone, .	W. H. Kingsley, . .	**Acton**, . . .	J. O'Neil, . .	5
2003-M, . .	Henry F. Taber, . .	**Acushnet**, . .	A. P. R. Gilmore,	10
48-2, . . .	John Clancy, . . .	**Adams**, . .	John Clancy, .	6
3165-11, . .	E. M. Hitchcock, . .	**Agawam**, . .	- -	-
151-32, Great Barrington.	J. H. Wilcox, State Line,	**Alford**, . .	- -	-
- -	James E. Feltham, . .	**Amesbury**, . .	A. L. Stover, .	3
174-3, . . .	A. F. Bardwell, . .	**Amherst**, . .	W. H. Smith, .	6
71-3, . . .	John H. Playdon, . .	**Andover**, . .	J. H. Playdon, .	4
35, . . .	Walter H. Pierce,[1] . .	**Arlington**, . .	W. H. Bradley, .	1
2-12, . . .	John T. Withington, .	**Ashburnham**, .	Chas. H. Pratt, .	5
- -	Wm. S. Green, . .	**Ashby**, . .	H. A. Lawrence, .	5
4-12, . . .	Chas. A. Hall, . . .	**Ashfield**, . .	- -	-
146-L, So. Framingham.	Horace H. Piper, . .	**Ashland**, . .	M. Geoghan, .	7
48-J or 72-4, .	Frank P. Hall,[1] . .	**Athol**, . . .	W. S. Penniman, .	6

[1] Chief of fire department.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
34-4,	Hiram R. Packard,[1]	**Attleborough,**	W. E. S. Smith,	7
5-17,	J. F. Searle,	**Auburn,**	J. F. Searle,	6
8072-4,	J. W. McCarty,	**Avon,**	W. W. Beals,	7
96-4 or 477-4,	Chas. E. Perrin,	**Ayer,**	D. W. Mason,	5
236-2,	Henry C. Bacon, P. O. Hyannis.	**Barnstable,**	H. C. Bodfish,	10
8-4,	A. E. Traver,	**Barre,**	G. R. Simonds,	6
3-12,	Elmer D. Ballou,	**Becket,**	- -	-
No telephone,	Chas. E. Williams,	**Bedford,**	W. A. Cutler,	1
10,	James A. Peeso,	**Belchertown,**	E. C. Howard,	6
8157-22, Milford,	L. Francis Thayer,	**Bellingham,**	H. A. Whitney,	7
409-W,	John F. Leonard,[1]	**Belmont,**	C. H. Houlahan,	1
No telephone,	Gideon H. Babbitt, Taunton, R. F. D., 1.	**Berkley,**	J. M. Alexander,	9
14-6,	Walter Cole,	**Berlin,**	E. C. Ross,	5
2-13,	Edson W. Hale,	**Bernardston,**	- -	-
168-12,	Robt. H. Grant,[1]	**Beverly,**	J. B. Brown,	2
22-2,	E. N. Bartlett,[1]	**Billerica,**	W. H. O'Brien,	4
475-L-1, Woonsocket.	Thomas Reilly,	**Blackstone,**	P. J. Gibbons,	6
10-1,	H. K. Herrick,	**Blandford,**	- -	-
9-21,	Everett M. Walcott,	**Bolton,**	C. E. Mace,	5
- -	- -	**Boston,**	D. H. Sullivan,	-
- -	Emory A. Ellis, Bournedale.	**Bourne,**	Edward D. Nickerson.	10
11-4, West Acton,	M. L. Wetherbee,	**Boxborough,**	C. E. Sherry,	5
- -	Harry L. Cole, Georgetown, R. F. D.	**Boxford,**	C. Perley,	3
17-3,	H. J. Shattuck,	**Boylston,**	R. B. Smith,	6
- -	James M. Cutting, South Braintree.	**Braintree,**	O. A. Hubbard,	8
No telephone,	T. B. Tubman,	**Brewster,**	J. E. Eldridge,	10
8-6,	Edwin S. Rhoades,	**Bridgewater,**	A. W. McFarland,	7
14-3,	Geo. E. Hitchcock,	**Brimfield,**	G. E. Hitchcock,	6
1041,	Harry L. Marston,[1]	**Brockton,**	R. H. Carr,	7
- -	Elbert L. Bemis,	**Brookfield,**	J. H. Conant,	6
376,	Geo. H. Johnson,[1]	**Brookline,**	D. G. Lacy,	-
Lampson & Goodnow Mfg. Co.	Wm. Sauer, Shelburne Falls.	**Buckland,**	- -	-
2-5,	Walter W. Skelton,	**Burlington,**	W. W. Skelton,	1
21060,	Lawrence Horton, Ponkapog.	**Canton,**	A. Hemenway,	7
- -	- -	**Cambridge,**	J. F. Donnelly,	1
8166, Concord,	Geo. E. Wilkins,	**Carlisle,**	G. G. Wilkins,	1
16-2,	Herbert F. Atwood,	**Carver,**	H. F. Atwood,	9

[1] Chief of fire department.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
W. N. Potter & Co.	Fred D. Legate,	**Charlemont,**	- -	-
32-3,	Carlos Bond, Charlton Depot.	**Charlton,**	J. D. Fellows,	6
11-12,	Geo. W. Ryder, West Chatham.	**Chatham,**	G. B. Bassett,	10
1597-4, Lowell,	Arnold C. Perham,	**Chelmsford,**	M. A. Bean,	4
- -	- -	**Chelsea,**[2]	J. A. O'Brien,	1
167-3,	Chas. D. Cummings,	**Cheshire,**	- -	-
8-2,	Myron E. Turner,	**Chester,**	- -	-
8004,	Chas. A. Bisbee, Bisbees,	**Chesterfield,**	- -	-
1492,	John E. Pomphret,[1]	**Chicopee,**	Z. Pilland,	6
No telephone,	Ernest C. Mayhew,	**Chilmark,**	A. S. Tilton,	10
- -	Edward Newton, North Adams, R. F. D.	**Clarksburg,**	- -	-
12-J,	Albert Fairbanks,	**Clinton,**	John Martin,	5
177-3 or 260,	Wm. J. Brennock,	**Cohasset,**	J. E. Grassie,	8
- -	J. D. Gilchrest,	**Colrain,**	- -	-
- -	Frank W. Holden,	**Concord,**	H. P. Richardson,	5
5-3,	Edgar Jones,	**Conway,**	- -	-
8001,	W. S. Gabb,	**Cummington,**	- -	-
58-11,	A. K. Cleveland,	**Dalton,**	- -	-
No telephone,	Thos. L. Thayer, North Dana.	**Dana,**	T. L. Thayer,	6
277-3,	Michael H. Barry,	**Danvers,**	G. E. Lame,	2
1383-41, New Bedford.	S. P. Hawes,	**Dartmouth,**	E. M. Munson,	10
35-R,	H. J. Harrigan,	**Dedham,**	J. T. Kennedy,	7
273-14, Greenfield,	Wm. L. Harris,	**Deerfield,**	- -	-
No telephone,	Alpheus P. Baker, South Dennis.	**Dennis,**	H. H. Sears,	10
29-3,	Ralph Earle,	**Dighton,**	D. F. Lane,	9
East Douglas, Central.	Wm. L. Church,	**Douglas,**	T. J. Libby,	6
373-1,	John Breagy,	**Dover,**	H. L. McKenzie,	7
3353-2,	Frank H. Gunther,	**Dracut,**	T. F. Carrick,	4
152-2,	F. A. Putnam,	**Dudley,**	I. H. Esterbrook,	6
No telephone,	A. W. Swallow,	**Dunstable,**	W. H. Savill,	4
22-2,	E. W. Soule, Box 15, Millbrook.	**Duxbury,**	H. A. Fish,	9
146-5,	R. H. Copeland, Elmwood.	**E. Bridgewater,**	Frank H. Taylor,	7
4-3,	E. J. Speight,	**E. Longmeadow,**	- -	-
- -	Adin L. Gill, North Eastham.	**Eastham,**	N. P. Clark,	10
2-11,	J. M. Dineen,	**Easthampton,**	- -	-
24-7,	John Baldwin, North Easton.[1]	**Easton,**	R. W. Melendy,	7
241-2,	Manuel S. Roberts,	**Edgartown,**	T. S. Wimpenny,	10

[1] Chief of fire department.

[2] No forest area.

List of Forest Wardens and Local Moth Superintendents — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
165-14, Gt. Barrington.	F. W. Bradford, Great Barrington.	Egremont, . .	- -	-
1-13, . . .	Harry L. Ryther, . .	Enfield, . .	Clinton Powell, .	6
No telephone, .	Chas. H. Holmes, Farley,	Erving, . .	- -	-
23-5, . . .	Otis O. Story, . . .	Essex, . . .	O. O. Story, . .	2
- -	- -	Everett,[2] . .	J. Davidson, .	1
1426-2 or 3493-3, .	Wm. P. Shaw, . . .	Fairhaven, . .	G. W. King, . .	10
- -	James H. Nugent, . .	Fall River, . .	J. H. Nugent, .	10
136-2, . . .	H. H. Lawrence, Teaticket.	Falmouth, . .	W. B. Bosworth, .	10
1421-W or 745, .	W. W. Colton, . . .	Fitchburg, . .	W. W. Colton, .	5
Hoosac Tunnel Pay Station.	H. B. Brown, Drury, .	Florida, . .	- -	-
15-5 or 76-5, .	Ernest A. White,[1] . .	Foxborough, .	S. J. Johnston, .	7
352-4 So. Framingham.	B. P. Winch, . . .	Framingham, .	N. I. Bowditch, .	7
67-3, . . .	E. S. Cook, . . .	Franklin, . .	J. W. Stobbart, .	7
- -	Andrew Hathaway, Assonet.	Freetown, . .	G. M. Nichols, .	9
191-M, . .	Geo. S. Hodgman, . .	Gardner, . .	T. W. Danforth, .	6
- -	Leander B. Smalley, Menemsha.	Gay Head, . .	J. W. Belain, .	10
4-2, . . .	Clinton J. Eaton, . .	Georgetown, .	C. J. Eaton, . .	3
4-15 Bernardston,	Lewis C. Munn, Turners Falls.	Gill, . . .	A. Tuttle, . .	6
547-5, . . .	Sydney F. Haskell, . .	Gloucester, .	H. J. Worth, . .	2
18-4, . . .	John S. Mollison, Williamsburg.	Goshen, . .	- -	-
- -	Rodney E. Bennett, Cuttyhunk.	Gosnold, . .	- -	-
Central, . .	Sumner F. Leonard, .	Grafton, . .	C. K. Despeau, .	6
55-4, . . .	C. N. Rust, . . .	Granby, . .	- -	-
4-12, . . .	Lawrence F. Henry, .	Granville, . .	- -	-
5-3, . . .	Daniel W. Flynn, . .	Gt. Barrington,	T. J. Kearin, .	6
443-M, . .	J. W. Bragg, . . .	Greenfield, . .	J. W. Bragg, . .	6
33-24, . . .	Wm. H. Walker, Greenwich Village.	Greenwich, .	B. A. Sawtelle, .	6
105, . . .	J. B. Harrington, . .	Groton, . .	J. F. Bateman, .	4
1026-X, . .	Sidney E. Johnson, . .	Groveland, . .	R. B. Larive, .	3
651-33, . .	Edward P. West, . .	Hadley, . .	- -	-
5-3, Bryantville, .	Jared B. Baker, . .	Halifax, . .	F. D. Lyons, .	9
No telephone, .	Fred Berry, Essex, R. F. D.	Hamilton, . .	E. G. Brewer, .	2
- -	Walter S. Beebe, . .	Hampden, . .	- -	-
Post office, . .	Chas. F. Tucker, . .	Hancock, . .	- -	-
8011-2, . .	Chas. E. Damon, North Hanover.	Hanover, . .	L. Russell, . .	9
8012-6, Bryantville,	Albert L. Dame, South Hanson.	Hanson, . .	A. L. Dame, .	9
No telephone, .	P. J. Humphrey, . .	Hardwick, . .	P. J. Humphrey, .	6

[1] Chief of fire department. [2] No forest area.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
46-3,	Benj. J. Priest,	**Harvard,**	G. C. Maynard,	5
Central,	John Condon,	**Harwich,**	Arthur F. Cahoon,	10
6-3,	John M. Strong, West Hatfield.	**Hatfield,**	John M. Strong,	6
4-2,	John B. Gordon,	**Haverhill,**	M. Fitzgerald,	4
121-3,	Melvin H. White, Charlemont.	**Hawley,**	- -	-
5-18,	S. G. Benson,	**Heath,**	- -	-
21305,	Geo. Cushing,[1]	**Hingham,**	T. L. Murphy,	8
- -	E. H. Goodrich,	**Hinsdale,**	- -	-
150, Randolph,	E. W. Austin,[1]	**Holbrook,**	F. T. White,	7
29-4,	Winfred H. Stearns, Jefferson.	**Holden,**	W. H. Stearns,	6
5-21,	Oliver L. Howlett, Southbridge, R. F. D.	**Holland,**	A. F. Blodgett,	6
1-2,	W. A. Collins,	**Holliston,**	Herbert E. Jones,	7
R. H. Dietz,	Cornelius J. Haley,	**Holyoke,**	- -	-
233-2,	Walter F. Durgin,	**Hopedale,**	W. F. Durgin,	6
Central,	R. I. Frail,	**Hopkinton,**	W. A. Macmillan,	6
25-13,	E. A. Young,	**Hubbardston,**	E. A. Young,	6
207-M,	Wm. L. Wolcott,[1]	**Hudson,**	F. P. Hosmer,	5
248-W,	Smith F. Sturges, Allerton.	**Hull,**	J. Knowles,	8
- -	Fred P. Stanton,	**Huntington,**	- -	-
42-6 or 100,	A. J. Barton,	**Ipswich,**	J. Morey,	3
- -	Arthur B. Holmes,	**Kingston,**	R. F. Randall,	9
261-2,	Nathan F. Washburn,	**Lakeville,**	N. F. Washburn,	10
218-13,	Arthur W. Blood,	**Lancaster,**	L. R. Griswold,	5
717-5, Pittsfield,	King D. Keeler,	**Lanesborough,**	- -	-
90,	Dennis E. Carey,	**Lawrence,**	I. B. Kelly,	4
66-5,	James W. Bossidy,	**Lee,**	- -	-
No telephone,	Chas. White, Cherry Valley.	**Leicester,**	J. H. Woodhead,	6
135,	O. R. Hutchinson,	**Lenox,**	M. O'Brien,	6
546 or 9,	Fred A. Russell,	**Leominster,**	D. E. Bassett,	5
9-44, Cooleyville,	O. C. Marvel, North Leverett.	**Leverett,**	- -	-
No telephone,	Azor P. Howe,	**Lexington,**	A. P. Howe,	1
248-11,	Jacob Sauter,	**Leyden,**	- -	-
56-5,	J. J. Kelliher, Concord, R. F. D.	**Lincoln,**	J. J. Kelliher,	5
17-4,	A. E. Hopkins,	**Littleton,**	A. E. Hopkins,	5
1233-2,	Oscar C. Pomeroy,	**Longmeadow,**	- -	-
201-21,	E. S. Hosmer,[1]	**Lowell,**	C. A. Whittet,	4
17-13,	Edward E. Chapman,	**Ludlow,**	- -	-

[1] Chief of fire department.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
20, ...	James S. Gilchrest, . .	**Lunenburg,** .	James S. Gilchrest,	5
1174, . . .	Herbert C. Bayrd, . .	**Lynn,** . . .	G. H. McPhetres, .	2
No telephone, .	Thos. E. Cox, Wakefield, R. F. D.	**Lynnfield,** . .	L. H. Twiss, .	1
– –	M. F. Enwright, . .	**Malden,** . .	W. B. Gould, .	1
283-2, . . .	John D. Morrison, . .	**Manchester,** .	J. D. Morrison, .	2
1-2, . . .	Herbert E. King,[1] . .	**Mansfield,** . .	Marvin J. Hills, .	7
No telephone, .	John T. Adams, . .	**Marblehead,** .	W. H. Stevens, .	2
117-2, . . .	Geo. B. Nye, . . .	**Marion,** . .	J. Allanack, . .	10
345-2, . . .	E. C. Minehan,[1] . .	**Marlborough,** .	M. E. Lyons, .	5
43-3, . . .	Wm. G. Ford, . . .	**Marshfield,** . .	P. R. Livermore, .	9
19-11 or 19-4, Cotuit.	Joseph A. Peters, . .	**Mashpee,** . .	W. F. Hammond,	10
25-2, . . .	E. C. Stetson, . . .	**Mattapoisett,** .	A. H. Dexter, .	10
123-11, . .	G. A. Gutteridge, . .	**Maynard,** . .	A. Coughlan, .	5
106-4, . . .	W. E. Kingsbury,[1] . .	**Medfield,** . .	G. L. L. Allen, .	7
138 or 53, . .	Chas. E. Bacon, . .	**Medford,** . .	W. J. Gannon, .	–
15-2 or 38-3, .	Clyde C. Hunt,[1] . .	**Medway,** . .	F. Hager, . .	7
– –	– –	**Melrose,** . .	J. J. McCullough, .	1
156-6, . . .	Frank M. Aldrich, . .	**Mendon,** . .	F. M. Aldrich, .	6
21-3, . . .	Edgar P. Sargent, . .	**Merrimac,** . .	C. R. Ford, . .	3
No telephone, .	Herbert Nichols, . .	**Methuen,** . .	A. H. Wagland, .	4
5 or 36, . .	Chester E. Weston, . .	**Middleborough,**	A. D. Nelson, .	9
9024-14, . .	Thos. H. Fleming, Bancroft.	**Middlefield,** .	– –	–
– –	Chas. O. Currier, . .	**Middleton,** . .	B. T. McGlauflin,	3
65-3, . . .	E. M. Crockett, . .	**Milford,** . .	P. F. Fitzgerald, .	6
– –	Harry L. Snelling, . .	**Millbury,** . .	E. F. Roach, .	6
5-2, . . .	Chas. La Croix, . .	**Millis,** . . .	E. W. Stafford, .	7
322, . . .	N. T. Kidder, . . .	**Milton,** . .	N. T. Kidder, .	8
No telephone, .	S. R. Tower, . . .	**Monroe,** . .	– –	–
12-22, . . .	O. E. Bradway, . .	**Monson,** . .	– –	–
278-15, Greenfield,	Fred T. Lyman, . .	**Montague,** . .	Dennis J. Shea, .	6
Post office, . .	D. C. Tyron, . . .	**Monterey,** . .	– –	–
3-24, Russell, .	Andrew J. Hall, . .	**Montgomery,** .	– –	–
No telephone, .	G. W. Patterson, . .	**Mt. Washington,**	– –	–
138, . . .	Thos. Roland, . . .	**Nahant,**[2] . .	T. Roland, . .	2
16-21, . . .	Geo. M. Winslow, . .	**Nantucket,** .	G. M. Winslow, .	10
31, . . .	B. E. Darling, . . .	**Natick,** . .	H. S. Hunnewell, .	7
195-1, . . .	Howard H. Upham,[1] .	**Needham,** . .	E. E. Riley, . .	7

[1] Chief of fire department. [2] No forest area.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
No telephone,	Chas. S. Baker,	**New Ashford,**	- -	-
2280,	Edward F. Dahill,[1]	**New Bedford,**	C. F. Lawton,	10
31-15, North Brookfield.	E. L. Havens,	**New Braintree,**	E. L. Havens,	6
- -	Henry P. Stanton,	**N. Marlborough,**	- -	-
Pay station,	Rawson King, Cooleyville.	**New Salem,**	R. King,	6
173-1, Newburyport.	Wm. P. Bailey, Byfield,	**Newbury,**	H. L. Bailey,	3
380,	Chas. P. Kelley,	**Newburyport,**	C. P. Kelley,	3
N. W., 33-1,	W. B. Randlett,[1] Newton Center.	**Newton,**	C. I. Buckman,	1
41-5,	Jas. T. Buckley,	**Norfolk,**	James T. Buckley,	7
205-4,	H. J. Montgomery,[1]	**North Adams,**	H. E. Blake,	6
821-3,	Geo. A. Rea,	**North Andover,**	Joseph W. Crockett,	4
17-3 or 209,	Preston D. White,	**N. Attleborough,**	F. P. Toner,	7
26-14,	Geo. O. Rollins,[1]	**N. Brookfield,**	S. D. Colburn,	6
33-3,	Henry Upton,[1]	**North Reading,**	G. E. Eaton,	1
165,	F. E. Chase,	**Northampton,**	Christopher Clarke,	6
14-5,	T. P. Haskell,	**Northborough,**	T. P. Haskell,	6
71-5, Whitinsville,	W. E. Burnap, Whitinsville.	**Northbridge,**	A. F. Whitin,	6
2-3,	Fred W. Doane,	**Northfield,**	F. W. Doane,	6
29-11,	Geo. H. Storer,	**Norton,**	G. H. Storer,	7
11-4,	John Whalen,	**Norwell,**	J. H. Sparrell,	9
55-4,	Frank W. Talbot,	**Norwood,**	Ebin F. Gay,	7
- -	Frank W. Chase,	**Oak Bluffs,**	P. P. Hurley,	10
17-5,	C. H. Trowbridge,	**Oakham,**	C. H. Trowbridge,	6
67-13,	F. M. Jennison,	**Orange,**	F. M. Jennison,	6
21-12,	Chas. F. Poor,	**Orleans,**	A. Smith,	10
- -	Durand A. Witter,	**Otis,**	- -	-
9-5,	Olin D. Vickers,	**Oxford,**	C. G. Larned,	6
65-11 or 53-3,	James Summers,[1]	**Palmer,**	C. H. Keith,	6
- -	Fred L. Durgin,	**Paxton,**	F. L. Durgin,	6
18-3,	M. V. McCarthy,	**Peabody,**	J. F. Callahan,	1
- -	Myron N. Allen,	**Pelham,**	- -	-
7-23, Bryantville,	Jos. J. Shepard,	**Pembroke,**	J. J. McFarlen,	9
54-3 or 12-5,	Geo. G. Tarbell,	**Pepperell,**	J. Tune,	4
- -	Walter H. Pike,	**Peru,**	- -	-
13-2,	Geo. P. Marsh,	**Petersham,**	David Broderick,	6
176-6, Athol,	W. H. Cowlbeck, Athol, R. F. D., 3.	**Phillipston,**	W. H. Cowlbeck,	6
149 or 964,	Wm. C. Shepard,[1]	**Pittsfield,**	- -	-

[1] Chief of fire department.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
18-31, Cummington Exchange.	E. L. Parker, . . .	**Plainfield,** . .	- -	-
- -	R. P. Rhodes, . . .	**Plainville,** . .	C. N. Snell, . .	7
197-W or 88-4, .	Herbert Morissey, . .	**Plymouth,** . .	A. A. Raymond, .	9
11-14, Kingston, .	T. W. Blanchard, . .	**Plympton,** . .	D. Bricknell, .	9
19-4, . . .	A. W. Doubleday, . .	**Prescott,** . .	C. M. Pierce, .	6
13-4, . . .	Fred W. Bryant, . .	**Princeton,** . .	F. A. Skinner, .	6
- -	- -	**Provincetown,** .	J. M. Burch, .	10
- -	A. L. Litchfield, . .	**Quincy,** . .	A. J. Stewart, .	8
86-W, . . .	Chas. A. Wales, . .	**Randolph,** . .	C. F. Blanche, .	7
1284-R, . .	John V. Festing, . .	**Raynham,** . .	G. M. Leach, .	9
- -	H. E. McIntire, . .	**Reading,** . .	H. M. Donegan, .	1
11-12, . . .	Benj. F. Monroe, Attleborough, R. F. D.	**Rehoboth,** . .	S. W. Robinson, .	9
- -	- -	**Revere,**[2] . .	G. P. Babson, .	1
4-2, . . .	T. B. Salmon, . .	**Richmond,** . .	- -	-
No telephone, .	D. E. Hartley, Mattapoisett, R. F. D.	**Rochester,** . .	G. W. Wilcox, .	10
55-4, . . .	John H. Burke, . .	**Rockland,** . .	F. H. Shaw, . .	9
27-3, . . .	A. J. McFarland, . .	**Rockport,** . .	F. A. Babcock, .	2
21-6, . . .	Merritt A. Peck, Zoar, .	**Rowe,** . .	- -	-
No telephone, .	Daniel O'Brien, . .	**Rowley,** . .	L. R. Bishop, .	3
279-2, Athol, .	L. G. Forbes, . . .	**Royalston,** . .	A. H. Brown, .	6
194, Springfield, .	S. S. Shurtleff, . .	**Russell,** . .	- -	-
13-3, . . .	Henry Converse, . .	**Rutland,** . .	H. E. Wheeler, .	6
- -	- -	**Salem,**[2] . .	A. Stillman, . .	2
- -	James Pike, . . .	**Salisbury,** . .	H. C. Rich, . .	3
Post office, . .	Lyman H. Clark, New Boston.	**Sandisfield,** .	- -	-
52-14, . . .	John F. Carlton, . .	**Sandwich,** . . .	B. F. Denison, .	10
115-3, . . .	Chas. L. Davis, . .	**Saugus,** . .	T. E. Berrett, .	1
3-3, . . .	H. H. Fitzroy, . .	**Savoy,** . . .	- -	-
- -	Henry T. Cole,[1] . .	**Scituate,** . .	P. S. Brown, .	8
399-L-5, Pawtucket.	John L. Baker, . .	**Seekonk,** . .	H. L. Thompson, .	9
121-2, . . .	A. A. Carpenter, . .	**Sharon,** . .	J. J. Geissler, .	7
24-2, . . .	Arthur H. Tuttle, . .	**Sheffield,** . .	- -	-
135-4, . . .	H. O. Fiske, Shelburne Falls.	**Shelburne,** . .	- -	-
11-4, Natick, .	Milo F. Campbell, South Sherborn.	**Sherborn,** . .	J. P. Dowse, . .	7
- -	A. A. Adams, . . .	**Shirley,** . .	A. A. Adams, .	5
- -	Edward A. Logan, . .	**Shrewsbury,** .	C. R. Webb, . .	6

[1] Chief of fire department.

[2] No forest area.

List of Forest Wardens and Local Moth Superintendents — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
2-14,	N. J. Hunting,	**Shutesbury,**	- -	-
- -	Wm. F. Griffiths, Swansea, R. F. D.	**Somerset,**	C. Riley,	9
- -	- -	**Somerville,** [2]	A. B. Pritchard,	1
724-1, Holyoke,	Lewis H. Lamb, South Hadley Falls.	**South Hadley,**	- -	-
153-2,	Dana Howland,	**Southampton,**	- -	-
13, Marlborough,	Harry Burnett,	**Southborough,**	H. Burnett,	6
11,	Aimee Langevin,	**Southbridge,**	A. Langevin,	6
- -	Benj. M. Hastings,	**Southwick,**	- -	-
77-4,	A. F. Howlett,	**Spencer,**	G. Ramer,	6
20, Indian Orchard.	T. J. Clifford, Indian Orchard.	**Springfield,**	W. F. Gale,	6
16-2,	G. F. Herbert, Pratts Junction.	**Sterling,**	J. H. Kilburn,	5
Post office,	Geo. Schneyer, Glendale,	**Stockbridge,**	Dr. H. C. Haven,	6
207-R,	Louis F. Bruce,	**Stoneham,**	G. M. Jeïts,	1
121-3,	James Curley,	**Stoughton,**	W. P. Kennedy,	7
145-R, Hudson,	W. H. Parker, Gleasondale.	**Stow,**	G. A. Patterson,	5
3-16,	Chas. M. Clark, Fiskdale,	**Sturbridge,**	C. M. Clark,	6
5-5,	S. W. Hall, South Sudbury.	**Sudbury,**	W. E. Baldwin,	5
46,	A. C. Warner,	**Sunderland,**	- -	-
49-16,	R. H. Richardson,	**Sutton,**	J. E. Gifford,	6
3106-3,	Geo. P. Cahoon, [1]	**Swampscott,**	E. P. Mudge,	2
- -	Thos. L. Mason,	**Swansea,**	A. E. Arnold,	9
320 or 1-3,	Fred A. Leonard, [1]	**Taunton,**	L. W. Hodgkins,	9
23-3,	A. R. Paine, Baldwinsville,	**Templeton,**	J. B. Wheeler,	6
12-2,	Harris M. Briggs,	**Tewksbury,**	H. M. Briggs,	4
102-3,	E. C. Chadwick, Vineyard Haven.	**Tisbury,**	H. W. McLellan,	10
- -	Clayton H. Deming,	**Tolland,**	- -	-
Central,	Chas. W. Floyd,	**Topsfield,**	C. W. Floyd,	3
11-2 or 37-2,	F. J. Piper, [1]	**Townsend,**	G. E. King,	4
No telephone,	Naylor Hatch,	**Truro,**	J. H. Atwood,	10
6-4,	Otis L. Wright,	**Tyngsborough,**	C. J. Allgrove,	4
1-22, Lee,	Geo. F. Knapp,	**Tyringham,**	- -	-
7-2,	E. M. Baker, [1]	**Upton,**	G. H. Evans,	6
31-12,	Lewis F. Rawson,	**Uxbridge,**	L. F. Rawson,	6
455-M or 58,	Wm. E. Cade, [1]	**Wakefield,**	W. W. Whittredge,	1
No telephone,	Warren W. Eager,	**Wales,**	M. C. Royce,	6
112-2,	Horace A. Spear, Jr.,	**Walpole,**	P. R. Allen,	7

[1] Chief of fire department. [2] No forest area.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
Post office, . .	Geo. L. Johnson, . .	**Waltham**, . .	W. M. Ryan, .	1
5-13, ...	L. A. Charbonneau, . .	**Ware**, ...	F. Zeissig, . .	6
45-23, ...	Delbert C. Keyes, South Wareham.	**Wareham**, . .	J. J. Walsh, . .	10
No telephone, .	Jos. D. Vigneaux, West Warren.	**Warren**, . .	A. A. Warriner, .	6
73-3, ...	Chas. A. Williams, . .	**Warwick**, . .	G. D. Sheperdson,	6
– –	Lester Heath, . .	**Washington**, .	– –	–
116, Newton North.	John C. Ford, . . .	**Watertown**, .	J. C. Ford, . .	1
56-4, Natick, .	C. S. Williams, Cochituate.	**Wayland**, . .	D. J. Graham, .	5
113-4, ...	Timothy Toomey, . .	**Webster**, . .	C. Klebart, . .	6
126-9, ...	Richard F. Evans,[1] .	**Wellesley**, . .	F. M. Abbott, .	7
– –	John Holbrook, . .	**Wellfleet**, . .	E. S. Jacobs, .	10
– –	Geo. J. Newhall, . .	**Wendell**, . .	G. E. Mills, .	6
74-2, ...	Jacob D. Barnes, . .	**Wenham**, . .	J. D. Barnes, .	2
3-21, ...	Fred E. Clark, . .	**West Boylston**, .	C. H. Baldwin, .	6
768, ...	W. P. Laughton, . .	**W. Bridgewater**, .	O. Belmore, .	7
No telephone, .	J. H. Webb, . . .	**W. Brookfield**, .	J. H. Webb, . .	6
5-4, ...	Moses Smith, . . .	**W. Newbury**, .	Frank D. Bailey, .	3
691-12, . . .	A. A. Sibley, . . .	**W. Springfield**, .	– –	6
– –	Geo. B. Latour, . .	**W. Stockbridge**, .	– –	–
203-23, . . .	Wm. J. Rotch, . . .	**West Tisbury**, .	H. W. Athearn, .	10
No telephone, .	J. H. McDonald,[1] . .	**Westborough**, .	Wm. Halloran, Jr.,	6
111-Y, . . .	T. H. Mahoney,[1] . .	**Westfield**, . .	– –	–
14-3, ...	John A. Healey, Graniteville.	**Westford**, . .	H. L. Nesmith, .	4
– –	C. A. Bartlett, . .	**Westhampton**, .	– –	–
15-22, ...	John C. Goodridge, .	**Westminster**, .	S. Whitney, . .	6
255-2, Waltham, .	Edward P. Ripley, . .	**Weston**, . .	E. P. Ripley, .	5
No telephone, .	Herbert A. Sanford, North Westport.	**Westport**, . .	H. A. Sanford, .	10
336, West Dedham,	Percy R. Dean, Islington,	**Westwood**, . .	C. H. Southerland,	7
– –	Edgar S. Wright, South Weymouth.	**Weymouth**, .	C. L. Merritt, .	8
69-2, South Deerfield.	James A. Wood, East Whately.	**Whately**, . .	– –	–
28-14, ...	C. A. Randall, . .	**Whitman**, . .	C. A. Randall, .	9
1-4, ...	Henry I. Edson, North Wilbraham.	**Wilbraham**, .	H. Starr, . .	6
37-21, ...	Fred J. Vining, Haydenville.	**Williamsburg**, .	– –	–
– –	William Davies, . .	**Williamstown**, .	– –	–
34-4, ...	Howard M. Horton, .	**Wilmington**, .	O. McGrane, .	1
29, ...	Arlon D. Bailey, . .	**Winchendon**, .	G. W. Drury, .	6

[1] Chief of fire department.

LIST OF FOREST WARDENS AND LOCAL MOTH SUPERINTENDENTS — *Con.*

Telephone Number.	Forest Warden.	Town or City.	Local Moth Superintendent.	Div. No.
123-2, . . .	David H. DeCourcy,[1] .	**Winchester,** .	S. S. Symmes, .	1
203-12, Dalton, .	Chas. D. Galusha, .	**Windsor,** . .	- -	-
- -	- -	**Winthrop,**[2] . .	J. A. Barry, .	1
110, . . .	Frank E. Tracy,[1] . .	**Woburn,** . .	J. H. Kelley, .	1
1947-W, . .	Arthur V. Parker, . .	**Worcester,** . .	H. J. Neale, . .	6
- -	Chas. Kilbourn, . .	**Worthington,** .	- -	-
21-3, . . .	D. Stanley Stone, . .	**Wrentham,** . .	W. Gilmore, . .	7
- -	Jos. W. Hamblin, . .	**Yarmouth,** . .	C. R. Bassett, .	10

[1] Chief of fire department. [2] No forest area.

TRIP TO EUROPE.

The State Forester was sent as a delegate to attend the meeting of the Second International Entomological Congress, which convened at Oxford, Eng., August 4 to 10, and to the Black Forest of Germany to study forestry conditions. The entire trip of six weeks was not only of great interest, but it is hoped it will prove of value in the State work. At Oxford there was an assembly of entomologists from all over the world, fourteen from America. The meetings were held in the old historic University buildings of Oxford, and the deliberations were of a very high order and participated in, in three languages, namely, English, French and German. Specialists were present who knew insect life of every phase, species and country, and it was an exceptional opportunity to exchange ideas and secure new information. The work of the suppression of the gypsy and brown-tail moths in Massachusetts I found was familiar to all, and in fact Massachusetts, its undertakings and accomplishments in its insect warfare, was frequently alluded to by various delegates as meriting the congratulations of all countries of the world. In talking with the delegates from other nations, and especially with those who had observed the habits of these insects in countries other than their own, it was interesting to compare their observations with our own. Instinctively, when in England, I found myself looking the trees over for the accustomed insect life, but without avail.

In talking with Dr. T. Algernon Chapman, an English entomologist, I was informed that, in his desire to propagate the gypsy moth in order to have plenty of specimens, he had actually imported them into England, and had endeavored to establish them on fruit trees at different times, but his undertakings had been a complete failure. In talking with Oberforester Fleck of Frankfort, Ger., I found that, while the gypsy moth was a harmful insect, nevertheless it appeared in sufficient numbers to be destructive only once in ten or twelve years, and even then the outbreak was nothing like that of our American infestation. One of the delegates reported that he had seen the gypsy moth in large numbers in northern Africa, where it had defoliated vegetation in a way similar to that in Massachusetts. Many others gave their experiences from observations, but, on the whole, they revealed nothing in addition to the facts given by Mr. W. F. Fiske and Dr. L. O. Howard, who have made a study personally of European and Japanese conditions, through the co-operative work on the part of Massachusetts and the United States Department of Agriculture.

From observations during my very brief stay in England, and from discussions with entomologists, I was particularly impressed with the fact that insect life generally never seems to reach the extremes there that it does in this country. This is true, I should say, not only in regard to insects affecting trees, but about those preying upon flowers and vegetables as well. It would seem to the writer that climatic conditions are largely responsible for this, for with such frequent precipitation vegetation is kept fresh and healthy, and at the same time insect life generally does not find the variety of conditions to favor its development which our climate, of greater extremes of heat and drought, assists. It may be that parasites are present and aid in keeping the balance, but it is believed that natural climatic conditions are great factors.

On the continent, conditions vary more or less from those of England, and outbreaks here seem to be more frequent and approach much nearer those in America; but even here the past season was comparatively cold and rainy, and therefore not as favorable to the development of insect life. I was, in fact, almost disappointed in not being able to find more forest insect depre-

A well-wooded mountainside of spruce in the Black Forest, Germany. These trees were all planted by the government and yield splendid returns.

A scene in the Black Forest, Germany, showing planted trees of all ages.

dations in the various countries than I did. I was interested in observing that while forest insects seem scarce, fruit insects and diseases seem relatively more numerous and destructive.

One thing that impressed the writer from a forestry standpoint was the definite system of management that prevailed, particularly in Belgium and Germany. With these countries their forestry is so reduced to definite rotations of tree crops, with comparatively few species, that the problem is a simple one. Our forestry conditions in Massachusetts, with the great variety of species, to say nothing of the varying ages and quality of the products, become conglomerate, showing a woeful lack of system in comparison. When we think of the Black Forest of Germany, we at once rightly associate it with spruce and fir, in the growing of which a great many depredations are eliminated, as neither the gypsy nor the brown-tail moth has to be considered, as neither attacks them. The beech forests, again, are quite another type, and hence their management, depredations, etc., require different treatment. In America it behooves us to establish similar policies, and thereby reduce silvicultural endeavors to systems that in themselves can be more easily and simply understood and handled.

In Belgium, the large national forest practically surrounding the city of Brussels was visited, and some time was spent in looking over the government's arboretum and nurseries, where most of our American species of trees are growing. It was like meeting old friends. Some of them seemed happy, while others were apparently more or less homesick.

In Switzerland my time was too short to make any extended trips, but in passing, a compliment should be given the Swiss foresters for the splendid results they have accomplished under many adverse conditions.

In Germany, several tramps were taken into the forest, sections of which were teeming with material for valuable observations and experiences. At Neustadt, Oberforester Wilder showed me every attention possible, and particularly emphasized his troubles as well as his successes. I was enabled here to see every phase of forestry work, from planting and nursery work through to the finished milled product. At Frankfort, Oberforester Fleck and Dr. M. Nassauer were particularly kind in showing me the forests

in that section, which are magnificent and alone worth the whole trip. A white pine stand fifty-five years of age was a splendid sight. (See frontispiece.) Trees of all ages and sizes can be seen here, and the experiments and results are very significant. At Darmstadt, the planting of sandy lands particularly was very interesting. Many other places were visited, each of which proved of more or less interest from a forestry standpoint, as to management, insect depredations, taxation, fire, etc., but it is my purpose to give a brief sketch of the trip at this time; other observations and notes taken at the time will be brought out later. No forester who is interested in his profession can go to the old world without securing a great fund of valuable suggestions and information that may prove of great profit to him in his life's work.

Better Forestry the Solution of the Moth Problem.

It may be recalled that the State Forester, upon assuming charge of the moth work, wrote a brief article for that year's annual report (1909, page 100) entitled "Modern Forestry and Insect Warfare." The purpose of calling attention to the same now, three years later, is to emphasize, with riper experience, the far-reaching application of the idea. The further we work and study on any problem the more the complex features fade away, and we finally get to the more simple and rational principles. The fight against gypsy and brown-tail moths has gone on up to now, and must continue, but it is believed that at the present time, although we have paid much for our experience and knowledge, we are in a far more satisfactory position to cope with them than most people realize. I do not wish to be misunderstood, for I am not saying that these insects are under control by any means, but I feel that if any intelligent person desires honestly to combat these pests, under any and all conditions, already there have been determined rational ways and methods which are effective.

Better methods of forestry management, which in the case of the moth-infested sections of the State will greatly depend upon silviculture, can be made extremely effective. Had we known what we do to-day it would have been a very simple thing to have saved the innumerable magnificent evergreens that were destroyed by the gypsy moth. As time has gone on, better organization and greater insistence for improved methods, materials, equip-

ment and machinery, together with natural and imported enemies and a more intimate knowledge of their workings, have all helped just so much. We need, therefore, combined co-operation to get the efficiency desired.

There is little question but that much of our work in the past, although effective, nevertheless has been altogether too expensive. The old idea of tearing down and burning out stone walls to destroy egg clusters appealed to some as effective, and it was, but to-day it is entirely abandoned. A few years ago burlap was used by hundreds of bales, and nearly every tree had a petticoat; but during the past season the ones seen were largely those hanging on from previous years, rather than new ones, other methods having proved better and taken their place.

To come to real fundamentals, our purpose in fighting the moths is to save our trees. We value our trees for two purposes — first, their æsthetic value for ornamental shade and beauty; and second, their economic value, as lumber and other forest products.

To get the best results with trees it is necessary to comprehend their wants in a very broad way. Adaptation of soils, proper distance apart for development, protection from forest fires in the country and leaky gas pipes and pavements in the cities, fungous diseases, insects, etc., must all be considered, each in its proper time and place.

In order, therefore, to combat any one of the above conditions or depredations the case as a whole first needs diagnosing. Now, if the brown-tail moth is the greatest factor to contend with the simplest solution is to grow evergreens, eliminating the hardwoods, as the brown-tail never touches evergreens. There are whole forests of evergreens alone in Europe. In the case of the gypsy moth it also so happens that where there are clear stands of evergreens this insect is little to be feared. It is for this reason that on the North Shore, for example, it will be seen that the oaks, which this insect adores, and other hardwoods are cut out, and the evergreens, like pine and hemlock, are retained and encouraged.

Without going further into detail, the point I desire to make is that a trained forester can and will, through his knowledge of the difficulties likely to be encountered with the gypsy and brown-tail moths, select his species and prepare and handle his wood

lots or forests in such ways as to obviate the difficulties. Through our observations we have found that many of our hardwoods species also are comparatively immune from these moths. The ash, locust, hickory and others, if selected and planted independently of those trees most coveted by the moths, would be relatively free. (See table, page 285.) If, in addition to silvicultural methods, as indicated, we also practice up-to-date forestry management by keeping the stand thinned out of dead wood and inferior and weakened trees, the results would be appreciable. Forest fires running through woodlands leave them in an unhealthy and unprofitable state, and it is here that moths and other depredations get their start, as the owner loses interest in such growth and feels it is not worth working with. These become the breeding places that later cause so much trouble.

With modern methods of management our forests will improve in every way. A forest properly thinned is more easily cared for, no matter what attacks it. Wherever we find wild, neglected woodlands, thickets and tangles along highways, or run-down and neglected estates, there are invariably the places where we expect to find the gypsy moth entrenched.

The first thing to be done with all our woodlands, therefore, is to practice modern forestry management for the benefit of future products, regardless of moths or other depredations; then let come what may, conditions are of the best for overcoming them.

There is little to be gained in treating egg clusters and combating insects on dead, decaying or ill-shaped and weed trees and stumps, as one's efforts ought to be centered on those that have prospective value.

The State Forester and his staff of trained assistants stand ready to assist any and every one in the State in the practice of modern forestry management. This once well established we predict that the insect depredations will be largely under control.

Forest Trees resistant to the Gypsy Moth.

With a view to finding out which species of trees are most resistant to the gypsy moth under general forestry conditions, the following data as to the feeding habits were collected by a trained forester. The work extended from July 10 to July 24, in areas which had been stripped by the gypsy moth. Sixty-

five plots were made for the examinations, located in 39 areas of stripping in 16 towns and the city of Boston. On 42 of these plots the trees were counted by species in $\frac{1}{4}$-acre circles; 8 were in scrub growth, or not much larger; the others were taken wherever conditions were favorable for getting comparative conditions for a fair study. In every case an estimate was made of the percentage of stripping, by species.

The table shows the average percentage of strippings of the different species on the plots actually counted.

PERCENTAGE OF STRIPPING.

SPECIES.	Percentage.	Basis (Number of Trees).
White oak,	94.0	871
Red oak,	89.0	156
Black oak (including scarlet),	84.0	1,084
Chestnut,	63.0	39
Hickory,	37.0	104
Red maple,	20.0	67
Gray birch,	14.0	365
White birch,	1.5	4
Beech,	72.0	8
Ash,	12.0	31
Black locust,	2.5	2
White pine,	5.0	127
Pitch pine,	–	5
Red cedar,	–	43
Black birch,[1]	50.0	5[2]
Elm,[1]	10.0	5[2]
Scrub oak,[1]	88.0	50[2]

[1] Not on counted plots. [2] Estimated.

This gives a fair estimate of the comparative resistance to the gypsy moth of the different species, with the exception of red oak. It so happened that the greater number of trees of this species observed were on areas where the stripping was particularly heavy, while on the areas where the general stripping was lighter there were very few red oaks. Thus the average obtained is exceptionally large. The individual plots show that where red

oak occurred with one or more other species of oak, it was stripped on an average of 10 per cent. less than any other. The detailed figures of the separate plots are not submitted with this report but are kept on file for reference if needed.

A number of cases were observed in which white oaks showed less stripping than the surrounding trees. In these cases the greater part of the white oak leaves were of recent growth. This and the presence of brown-tail pupa cases seemed to indicate that the white oaks had been stripped by brown-tails early in the season. At the time of the gypsy work there was little foliage left on these trees, and consequently the gypsy caterpillars either died or migrated to neighboring trees. The new leaves sprouted before the end of the gypsy season, but the caterpillars did not return to the white oaks.

Signs of the wilt disease were seen in most of the areas examined. In many cases this was undoubtedly natural.

A number of egg clusters were examined. None of these contained more than approximately 250 eggs, while many were much smaller. This is a natural result of the stripping, which prevented the caterpillars from obtaining their full growth.

Examinations of Woodlands.

Our well-founded policy of encouraging private woodland owners to manage their holdings according to established forestry principles has been continued very successfully during the past year. The number of examinations made (showing an increase over last year) seems to justify the hope, expressed in our last report, that this line of work is becoming sufficiently well known to be taken advantage of by citizens all over the State.

Chestnut Bark Disease.

While the number of examinations of woodland for the purpose of giving advice in forestry management has surpassed last year's mark, as noted, the work of examining for bark disease, which was then just beginning, has increased very rapidly indeed, so that in place of the 6 examinations made last year we are able to report a total of 28, not including several inspections made of lots previously examined. The wide prevalence of the disease

gives us every reason to believe that this work will increase rather than diminish during the coming year.

The two following tables give lists of the forestry and bark disease examinations made during the past year.

Examinee.	Town.	Area (Acres).	Cost.
Adams, Chas. F.,	Concord,	300	$0 75
Alexander, Samuel,	Northfield,	30	4 00
Allen, G. H.,	Billerica,	50	39
Amesbury Park Board,	Amesbury,	6	4 08
Andover Park Board,	Andover,	25	1 00
Angier, E. H.,	Ashland,	30	1 05
Balch, Anna L.,	Boston,	1	-
Balch, Francis N.,[1]	Billerica,	87	40
Barton, N. B.,	Sharon,	2	50
Bay State Street Railway Company,	Avon,	6	45
Bay State Street Railway Company,	Dighton,	1	75
Bay State Street Railway Company,	Taunton,	10	75
Bay State Street Railway Company,	Westwood,	10	20
Brookline Water Commissioners,	Dedham,	-	-
Brookline Water Commissioners,	Needham,	-	-
Brookline Water Commissioners,	Boston,	350	-[1]
Clark, Mrs. Elton P.,	Framingham,	10	1 10
Commission Public Works,	Lynn,	2,600	40
Crane, Dr. Clarence E.,	Dover,	40	15
Crocker, Mrs. Annie W. P.,	Foxborough,	175	1 30
Curtis, Frederick H.,	Dover,	16	57
Dame, J. R.,	Marshfield,	40	1 28
Dean, Herbert W.,	Cheshire,	2	-[1]
Dennison Manufacturing Company,	Framingham,	52	1 00
Fales, L. F.,	Walpole,	60	1 00
Fitzpatrick, Thomas M.,	Hopkinton,	80	50
Fuller, Edward,	North Andover,	108	70
Gordon, Dr. W. C.	Littleton,	15	1 30
Guptill, H. E.,	Georgetown,	4	2 94
Hathaway, M. B.,	Wilmington,	36	80
Hillside Industrial School,	Greenwich,	8	-
Houghton, L. T.,	Sutton,	50	2 20
Hunnewell, Hollis,	Natick,	250	2 43

[1] Transportation furnished.

Examinee.	Town.	Area (Acres).	Cost.
Lawrence, James,	Groton,	250	$4 18
Lufkin, C. O.,	Hubbardston,	60	1 50
Lythgoe, Mrs. Wm. F.,	Sharon,	4	50
Manning, John B.,	Boston,	4	25
Marlborough Water Commissioners,	Marlborough,	20	1 16
McQuaid, John,	Pittsfield,	40	–[1]
Means, Anne M.,	Andover,	5	92
Merrill, Dr. John L.,	Pembroke,	36	–[1]
Morgan, Paul B.,	Hubbardston,	40	5 25
Mount Holyoke Company,	Hadley,	240	6 55
Osgood, Isaac,	North Andover,	7	75
Parkinson, John, Jr.,	Dover,	14	–
Peabody Water Works,	Peabody,	98	80
Pierce, M. E.,	Berkley,	75	–
Place, C. A.,	Sterling,	30	1 60
Rogers, Edward H.,	Lincoln,	25	80
Sanderson, Geo. A.,	Littleton,	100	1 08
Sedgwick, Ellery,	Ipswich,	40	1 25
Shaw, J. Holbrook,	Plymouth,	10	1 60
Souther, Mrs. C. H.,	Boston,	2	–
Springfield Water Commissioners,	Blandford,	5	–
Springfield Water Commissioners,	Belchertown,	5	4 50
Sudbury Poor Farm,	Sudbury,	100	74
Walpole, town of,	Walpole,	19	–[2]
Wellesley College,	Wellesley,	15	–[2]
Westborough Insane Hospital,	Westborough,	10	2 72
Whitin Machine Works,	Northbridge,	40	2 78
Total,		5,748	–

[1] Transportation furnished. [2] No expense.

Examinee.	Town.	Area (Acres).	Disease Present.	Cost.
Ames, John S.,	Easton,	100	(?)	$0 90
Ames, Oakes,	Easton,	100	Yes.	–
Bay State Street Railway Company,	Avon,	6	No.	–
Bird, C. S.,	Walpole,	50	Yes.	80
Bowlker, Nathaniel,	Framingham,	100	No.	–
Briggs, F. H.,	Sharon,	30	Yes.	–

View of a fireline at Darmstadt, Germany, taken by the Massachusetts State Forester. The soil is a deep sand and the trees are Pinus sylvestris. Our Cape lands are far superior to this.

A view of a paved street extending through the government forest in the proximity of Brussels, Belgium. This large forest tract is mostly beech, and is valued æsthetically as well as economically.

Examinee.	Town.	Area (Acres).	Disease Present.	Cost.
Burlen, Wm. H.,	Sherborn,	80	Yes.	-
Carpenter, S. I.,	Sharon,	6	Yes.	$0 80
Channing, Walter M.,	Wellesley,	47	Yes.	-
Clark, Mrs. Elton P.,	Framingham,	30	No.	-
Codman, M.,	Framingham,	10	No.	-
Daniels, F. T.,	Sherborn,	1 tree.	No.	-
Felton, Fred S.,	Bolton,	150	Yes.	1 60
Hannum, William H.,	Williamsburg,	200	Yes.	-
Hyde, Louis C. (trustee),	Chicopee,	400	Yes.	4 45
Hyde, Louis C. (trustee),	Springfield,			
Joslin, Elliott P.,	Oxford,	3	Yes.	-
Lasell, C. W.,	Northbridge,	10	No.	2 95
Marshall, Lewis P.,	Walpole,	10	No.	80
Metropolitan Water Board,	Marlborough,	-	Yes.	-
Metropolitan Water Board,	Clinton,	-	Yes.	-
Metropolitan Water Board,	Southborough,	50	Yes.	-
Packard, Mrs. J. S.,	Seekonk,	2	Yes.	2 00
Pearmain, J. D.,	Framingham,	70	Yes.	40
Pierce, Mrs. E. J.,	Newton,	½	No.	-
Saltonstall, John L.,	Bolton,	152	No.	1 00
Smith, Harry W.,	Grafton,	60	Yes.	1 30
Sylvester, H. D.,	Williamsburg,	20	Yes.	-
Trott, George S.,	Bolton,	5	No.	-
Warren, Fiske,	Harvard,	600	Yes.	2 77
Total,		2,291½	-	-

Surveying.

The work of surveying land turned over to the State for planting, mentioned in our last report, has this year been pushed to completion, so that we now have on file maps for all lots planted by us under the reforestation act. This undertaking has involved the survey and mapping of 22 separate lots of land in all parts of the State, comprising a total area of 915 acres. Following is a list of these lots:—

Name of Lot.	Town.	Area (Acres).
Ballou,	Shirley,	17½
Bent,	Hubbardston,	69
Bent,	Hubbardston,	111
Cadwell,	Pelham,	7½
Cadwell,	Pelham,	16½
Civic League,	Nantucket,	83
Clark,	Holden,	55
Dean,	Rutland,	55
Dewar,	Carlisle,	35
Fenno,	Westminster,	35
Flint,	Andover,	38
Fullam,	West Brookfield,	75½
Gerrett,	Greenfield,	4
Glazier,	Leverett,	66
Glazier,	Leverett,	25
Killam,	Rowley,	31
Lamb,	Hubbardston,	51
Parkinson,	Dover,	14
Stone,	Brookfield,	40
Wilson,	Spencer,	15
Wilson,	Spencer,	25
Wilson,	Spencer,	46
Total,		915

The total surveyed area for which maps have been made by the forestry department is now 1,558 acres.

Steven's Estate, Warwick.

In October of last year this office made an examination and report on 55 acres of land belonging to the Steven's estate in Warwick. One-half of this area had been logged some years before, and had come up to a growth of hardwood sprouts and bushes. We advised in our report that this land should be deeded to the Commonwealth and planted by this office under the terms of the reforestation act. This was done and the land was planted last spring.

About two-thirds of the remaining 30 acres was covered with a second-growth stand of tall sapling pines; the remaining third

held a hardwood stand of sprout chestnut, white birch, oak and maple. It was advised in our report that the pine stand should be thinned, that is, the crowded, slow-growing trees should be cut out, and that the chestnut and white birch among the hardwoods should be removed. It was thought advisable to cut the chestnut on account of the danger of infection by the chestnut bark disease, and the white birch, because it was mature and seemed to be deteriorating in quality.

The recommendations of our report in regard to the thinning were accepted by the trustees of the estate, and six of our men, with one of our most experienced foremen, were set to work in the woods. The Steven's estate paid the entire cost of the work, including the expenses of the forester from this office who marked the trees and supervised the work. Arrangements were made with Mr. Williams, a local lumberman, to take the logs on the ground for $8 per M feet. Considering the conditions this was a very fair price. The slash and dead wood were piled but not burned, as it seemed impossible to do this without scorching and killing many of the standing trees.

The financial results of this operation should interest those who have wood lots in which thinning is a possibility. The amount of lumber sawed from the logs came to 235,000 board feet, and at the selling price of $8 per 1,000 the gross returns were $1,880. The labor cost of chopping and slash piling was $600; tools, $30; supervision, *i.e.*, expenses of the forester, $25; miscellaneous, $15; total, $670, or $2.90 per 1,000 feet. This leaves a net return of $5.10 per 1,000 feet, — a very good margin of profit for an operation carried out primarily for improvement to a wood lot situated more than 10 miles from the railroad.

Experimental Thinning.

A work which should prove to be of considerable interest when the final results are obtained has been begun in the town of Cheshire. The object of this undertaking is to learn the cost of thinning out the valueless species among the thick second-growth hardwood which comes up on the slopes of the Berkshires after the older trees have been cut off.

These slopes are covered largely with this sort of growth, which in the course of fifty years or so, by a process of natural thinning,

again becomes fit for fuel. If it can be shown that the growth of these trees can be so hastened by cutting out the inferior species as to produce the same amount of fuel wood per acre in thirty-five to forty years as now grows in fifty, and if this work can be done for a sufficiently low price per acre to make the financial result profitable, then the purpose of this experiment will have been fulfilled. For a woodland owner can well afford to pay the cost of removing these poorer trees, even when too small to be of any value, provided the remaining trees grow much faster and straighter, and show better quality.

While it is our belief that this result will be accomplished, we have no actual data at hand to prove it. As we always have held that facts are more useful than theories, we hope by the time four or five years have elapsed to be able to show conclusive results.

The method of making the experiment was this: two quarter acre plots were laid off side by side, so marked as to be clearly distinguishable. One of these plots was left untouched; the other was marked by a forester and all the marked trees were cut and drawn out. Data as to costs, number of trees thinned, number left, etc., are not available at this writing, but soon will be, and examination of the plots from year to year will reveal the progress of the growth. When sufficient time has elapsed we hope to have at hand "visible" data, so to speak, of a sort which, so far as we know, does not now exist in this section of the country.

Forest Working Plan.

One working plan has been made this year for the forested watershed of the city of New Bedford, in the towns of Freetown, Lakeville, Middleborough and Rochester. As a printed report of the working plan has been published by the city only a brief summary will be given here.

The complete plan consists of (1) an examination, with estimates and recommendations; and (2) a forest map based upon surveys, both area and timber; it was made as the result of a preliminary examination made by us in September, 1911, and covers an area of 1,510 acres.

The growth was divided into types, each of which was estimated separately. Then general recommendations, divided principally into thinning, planting, establishment of a nursery and

provision for fire protection, were made, followed by specific treatment for each type. A table was included giving instructions for handling a given portion of the tract each year, so that after a certain period has elapsed the whole area will be under management.

The city has begun to follow out the recommendations made in the report, and last spring started a nursery under the direction of this office.

Reforestation.

The reforestation policy of this office has been gaining strength throughout the Commonwealth by the awakening of the interest of private land owners in this kind of work. The fact that New Hampshire is also endeavoring to pass a similar law shows our reforestation law to be one of merit.

The work done during the past four years under the provisions of the reforestation act is beginning to show the practicability of planting forest trees on our waste lands. The plantations set in 1909 and 1910 are now large enough to attract the attention of people passing by.

This office has, up to the present time, planted about 80 lots of land in different sections of the State. During the past summer all these plantations were inspected, and reports made on the conditions of each lot. Where a considerable number of trees had died from the severe drought of the summer of 1911, or from other causes, it was decided to fill in the blanks so caused with new trees. This part of the work has been pushed with vigor during this fall, so that now nearly all of the 1909 and 1910 plantations are in good condition, and need no further attention beyond the cutting of brush and protection from fire.

A few of the plantations set late in the spring of 1912 were somewhat affected by the drought of this past summer, and will require some filling in another year.

Twenty-nine plantations, comprising a total acreage of 810 acres, were set out this past year with three and four year old transplant stock, all raised in our own nursery at Amherst. The number of trees set amounted to more than a million.

We also cleared and burnt over an 87-acre tract of cut-over pine land upon which the slash was very dense. A fire line was built along the entire length of the west side of the lot where it

adjoins the railroad. This land will be planted the coming spring. We have on hand at this time about 500 acres of land for planting in 1913, and expect to add materially to this amount.

We feel that that portion of the reforestation law which limits the price of land to $5 per acre should be amended to read $10, because with the present low limit it is difficult to obtain land situated in places where the plantation can be seen by any considerable portion of the public, so that the educational effect of the law is largely lost.

Forest Nursery.

Our special appropriation of $4,000 for nursery work has enabled us to reach the goal which we have long desired, namely, to raise in our own nursery an amount of transplant stock sufficient for our own needs and also be able eventually to supply forest nursery stock to State institutions and commissions. During the past year we furnished the Metropolitan Water and Sewerage Board with 250,000, the Mt. Wachusett Reservation Commission with 20,000 and the Westfield State Sanatorium with 5,000 two-year-old white pine seedlings.

During the past few years we have lost a portion of our seedling and transplant stock from drought, and have been handicapped because there was no water supply at the nursery. This last spring we laid a water pipe, with uprights for hose connection at regular distances, in the Amherst nursery. This system was connected with that of the Massachusetts Agricultural College. At Sandwich we draw the water from a pond, and make use of one of the old discarded power sprayers transferred from the gypsy moth division for pumping purposes. This works well.

The seedlings of this year promise to make a fine stand and the transplants have also made remarkable growth. We have tried the experiment this year of doing a large amount of fall transplanting, and the small trees appear to be in fine condition and able to stand the coming winter weather. In addition to the stock at our Amherst and Sandwich nurseries we have at Hopkinton about 125,000 four-year-old white pine transplants which were not used this past year. The equipment at Amherst has been increased by a large shed to hold boxes and baskets, and at Sandwich a shed was built to hold the sprayer pump mentioned above.

From our nurseries we shall have on hand next spring over a million and a half three and four year old pine and spruce transplants, and a very large number of two and three year old seedlings. A table showing the stock in our various nurseries follows: —

SANDWICH NURSERY, 1912.

Variety.	Age (Years).	Number of Trees.
Catalpa speciosa seedlings,	3	3,000
Black locust seedlings,	4	8,500
Black locust seedlings,	3	4,700
Honey locust seedlings,	3	2,800
Scotch pine seedlings,	3	25,000
Scotch pine seedlings,	1	50,000
Austrian pine seedlings,	2	20,000
Pitch pine transplants,	4	114,000
Black locust transplants,	4	114,000
Norway spruce transplants,	3	85,500
Jack pine transplants,	3	500
Total,	. . . . .	428,000

HOPKINTON NURSERY, 1912.

White pine transplants,	4	125,000

AMHERST NURSERY, 1912.

White pine seedlings,	1	1,701,100
White pine seedlings,	2	1,332,800
White pine seedlings,	3	259,200
Red pine seedlings,	1	187,900
Norway spruce seedlings,	1	211,200
Norway spruce seedlings,	2	1,015,800
European larch seedlings,	1	47,500
White ash seedlings,	1	65,000
White ash seedlings,	2	7,500
Catalpa speciosa seedlings,	2	1,700
Chestnut seedlings,	2	1,000
Maple seedlings,	2	200
Total seedlings,	. . . . .	4,830,900

AMHERST NURSERY, 1912 — *Concluded.*

Variety.	Age (Years).	Number of Trees.
White pine transplants,	4	82,500
White pine transplants (spring),	3	725,300
White pine transplants (fall),	3	589,000
Norway spruce transplants,	4	15,000
Red pine transplants,	3	14,000
Fir balsam transplants,	3	22,400
Hemlock transplants,	3	2,800
Arborvitæ transplants,	3	7,000
Total transplants,	. . . .	1,458,000
Grand total,	. . . .	6,288,900

PLANTING DONE UNDER THE ADVICE OF THIS OFFICE.

Name.	Town.	Variety.	Number of Trees.
Metropolitan Park Commission,	-	White pine,	250,000
Wachusett Reservation Commission.	-	White pine,	20,000
Daniel O'Brien,	Rowley,	White pine,	5,000
F. W. Williams,	Northfield,	White pine,	2,000
Marlborough Water Board,	Marlborough,	White pine,	20,000
Springfield Water Commission,	Blandford,	White pine,	5,000
Springfield Water Commission,	Belchertown,	White pine,	5,000
Charles G. Washburn,	Princeton,	White pine,	2,000
Fall River Water Commission,	Fall River,	White pine,	20,000
New Bedford Water Commission,	New Bedford,	White pine and Norway spruce.	30,000

STATE PLANTATIONS, 1912.

Town.	Acres.	Type of Land.	Variety planted.
Templeton,	50	Cut-over,	White pine, Norway spruce.
Heath,	80	Run-out pasture,	White pine.
Hopkinton,	28	Sprout land,	White pine, Norway spruce.
Buckland,	11	Cut-over,	White pine.
Hopkinton,	80	Cut-over,	White pine, Norway spruce.
Norwell,	10	Cut-over; pasture,	White pine.

STATE PLANTATIONS, 1912 — *Concluded.*

Town.	Acres.	Type of Land.	Variety planted.
Ashburnham,	28	Pasture,	White pine.
Barre,	38	Cut-over,	White pine.
Dover,	13½	Cut-over,	White pine.
Oakham,	80	Cut-over,	White pine.
Becket,	10	Pasture; mowing,	White pine.
Duxbury,	38½	Cut-over,	White pine.
Warwick,	28	Cut-over,	White pine.
Wellfleet,	6½	Cut-over; sandy,	Scotch pine.
Ashburnham,	70	Old pasture,	White pine.
Paxton,	50	Cut-over,	White pine.
Greenfield,	4	Old field,	White pine.
East Brookfield,	30	Cut-over,	White pine.
Hubbardston,	15	Cut-over,	White pine.
Belchertown,	6	Old pasture,	White pine.
Shirley,	18	Cut-over,	White pine.
Shirley,	10	Old pasture,	White pine.
Hubbardston,	12	Cut-over; plain,	White pine.
Lancaster,	40	Cut-over; plain,	White pine.
Ashburnham,	19	Old field,	White pine.
Ashburnham,	6	Old field,	White pine.
Ashburnham,	4	Old field,	White pine.
Dennis,	20	Cut-over sprout,	White pine, Austrian and Scotch.
Spencer,	5	Cut-over,	White pine.

PROPOSED PLAN FOR DOING FORESTRY WORK ON STATE RESERVATIONS AND ON STATE LANDS.

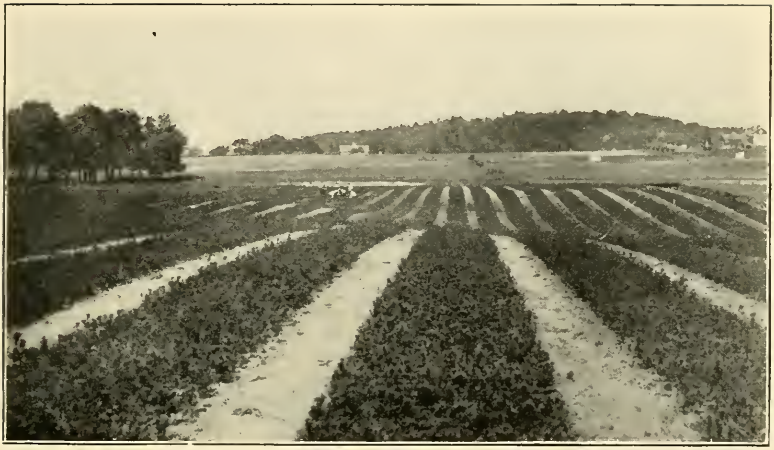
There are many State institutions and reservations that have areas of land that should be placed under better systems of forestry management, either by proper thinning or reforesting. The State Forester is in a position to assist these institutions in the future by offering them young trees from his nurseries free of charge. He also will be at their service in outlining systems of forestry management and in assisting in other ways in establishing a definite forest policy. Surely those in charge should be able to find some source whereby the manual labor expenses could be met. In consulting with the Greylock Reservation Commission, for example, we find that they are under considerable outlay in

maintaining roads, and the general expenses are as much as they are able to finance. With an acreage of 8,000 acres, some of which is wooded and a large percentage of it capable of being reforested, it would seem that the State is derelict in its duty in not setting the private land-owner a good example by practicing upon its own land the principles of forestry management. What is true of Greylock is more or less true of other reservations and lands owned by the State at various institutions.

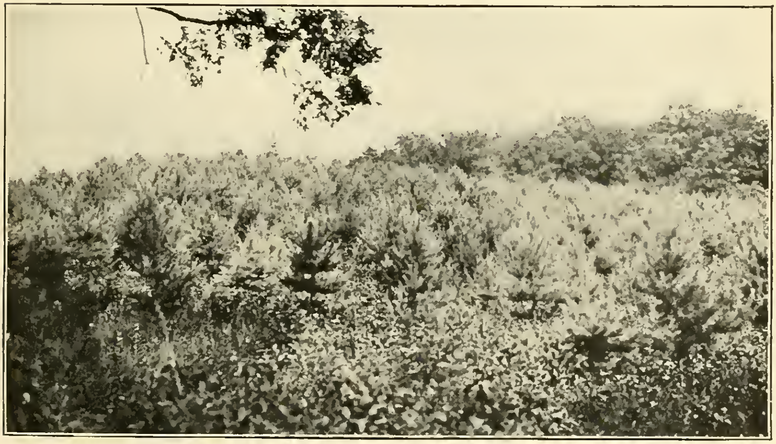
As a means of getting some real active forestry work started on these lands the State Forester might be given a small yearly appropriation for doing work of this sort in co-operation with the various boards. Should this be done it is suggested that the receipts from this work thereafter should be turned over to the State through the State Treasurer. Were we to spend $5,000 a year simply for manual labor in thinning existing growth or setting out young trees, it will be seen that the expenditure would go very far toward getting done just what is necessary.

Forest Taxation.

It has long been known to the observant that the present unjust method of taxing forest lands has constituted one of the most formidable obstacles to the development of forestry in this State. Under the present law all property, both real and personal, is subject to taxation to provide the revenue necessary to defray the running expenses of municipal, State and national government. This law applies to forest lands the same as to other kinds of property, and requires an annual assessment of taxes based upon the true value of the land, together with the trees growing thereon. The evil of this common practice has been made painfully apparent by the action of the owners of such property, who to escape this burdensome tax seek relief by cutting and marketing the trees while very immature, and long before they have attained their highest commercial value. The question of taxation has also served to retard the progress of the reforestation movement, the importance of which to the economic welfare of the State is of such magnitude as to fairly entitle it to any reasonable concession, of whatever nature, which may have a tendency to encourage and foster it. By the authority given it by the amendment to the Constitution adopted by the voters



The State Forester's nursery at Amherst, taken in July.



A Scotch pine plantation on the estate of Mr. Charles Francis Adams in Lincoln, Mass.

at the last State election, the General Court of 1913 will undertake the rather difficult task of solving the forest taxation problem by legislation.

So intricate is the subject, and so vital is it that proposed legislation along this line should be thoroughly well considered, that the Boston Chamber of Commerce has joined with the Massachusetts Forestry Association in the appointment of a committee to study the problem and to prepare a bill designed to eliminate many of the objectionable features of the present method of taxing these lands. It is difficult to determine, or even forecast at this time, in just what form this bill will be presented to the Legislature for its consideration.

That which is needed is such changes in the present method as will encourage tree planting and the conservation of forests without relieving the forest owner of his responsibility of giving his just share toward the support of government. If this taxation problem is successfully worked out, a long step will have been taken in the right direction, and forestry will eventually become one of the leading factors in contributing to the wealth and prosperity of the State.

Present Conditions regarding the Chestnut Bark Disease in Massachusetts.

While the whole forestry staff has been on the lookout for this disease throughout the year, nevertheless it was deemed best to have a general inspection of the State made, and Mr. John Murdoch, Jr., was delegated to do this. He visited the worst infected sections that he was familiar with from his work of last year, and submitted the following report: —

In southern Berkshire County the disease, as has already been reported, is almost universally distributed. A number of cases were found which had not previously been reported, either from having been overlooked under the conditions of observation last winter, or in territory not then covered. A number of cases also were discovered which had first become evident during the past summer, amounting in all to perhaps 100 per cent. increase. Careful examination of many cases, however, led to the conclusion that most of the apparent increase was due to lesions which had started in 1911, but which had not killed the host until 1912. On trees

which were previously infected, the disease seems to have made comparatively little headway during the past season. Even at the locality in Alford which was reported as the worst seen in the State last year, and which still maintains that reputation, no new trees seemed to have died, and the disease had increased but little. A few new lesions were observed in some places throughout the county, principally on small twigs, including one apparently on the new growth of the year.

A former employee of the Pennsylvania Blight Commission says that the infection in this region is more general than he has seen it even in eastern Pennsylvania and New Jersey. In these States the diseased trees occur in more or less widely separated groups, while here they are commonly uniformly distributed throughout the stand.

In Wilbraham and Hampden, Hampden County, the disease is as widely distributed as in Berkshire County, and the increase for 1912 is apparently no greater. On one tract of sprout growth observed by Mr. Robert I. Edson, forest warden of Wilbraham, on which every tree is attacked, the disease has made very little headway the past year. Mr. Edson is the man who first called the attention of this office to the presence of the disease in Massachusetts.

Lumbermen in Hampshire County say that the disease has made a great spread there. It seems probable, however, that this is due rather to better recognition of the disease than to an actual increase.

In southeastern Worcester County very little fresh work was seen. In particular, one of the group of sprouts in the town of Douglas, photographed in January, 1912, which at that time had a fair-sized canker on the trunk, was on October 3 still green in the top. The canker was larger but had not spread completely around the trunk, although this was only four inches in diameter. The larger tree, photographed the same day, had lost only one additional branch.

All over the State, with the possible exception of Hampshire County, as noted above, the disease seems to have made much less headway than was to have been expected from its previous rate of spread.

It is reported that experimental inoculations in Pennsylvania

show that the disease develops more rapidly in the valleys than towards the top of the ridges. Mr. Edson states that he has observed the disease growing much more rapidly in trees on the edge of a fertilized field than in trees on a rocky knoll near by.

Successful inoculations are said to have been made on a number of other trees besides chestnut, including oak, — species not given, — tulip-poplar, and sumach, though there are no reports of natural infection on these trees.

A recent writer in "Phytopathology" states that he has determined the fungus known in Europe as *Endothis radicalis* to be identical with the so-called *Diaporthe parasitica* of America. This fungus, although long known, has never been reported as producing any disease in Europe. This article is simply a confirmation of the identification made some time ago by Dr. W. G. Farlow. It is said that inoculations with the European fungus on American chestnuts have produced the disease.

It has been discovered that, under favorable conditions, the ascospores — the "winter spores" of the publications — may be shot to a distance of several centimeters from the surface. They may then be taken up by the wind and carried to an indefinite distance. The possibility of spreading by the wind was suggested in the pamphlet published by this office last spring. The spores are covered with the sticky contents of the ascus, and adhere firmly to whatever they strike. It is impossible to blow them from a plate of glass even, and very difficult to wash them off with a stream of water.

The phenomenon shown in Figure 1 of the above pamphlet is probably not the early stage of the disease, as there stated. It is undoubtedly caused by an insect called the "Chestnut Bast Miner," the larva of which was only recently discovered. The adult is as yet unknown. The galleries of this insect do, however, form a very common point of attack for the disease.

The Bureau of Entomology has recently announced the discovery of five species of insects which feed on the pustules of the bark disease fungus, and by thus destroying the spores check its spread to a greater or less extent.

Record has been made of all known stations of the disease in this State on a set of maps kept for that purpose.

Danger from Slash.

It is thought best to call attention again to the great forest fire losses occurring yearly from the slash following logging operations. In a State like Massachusetts, where during the summer season our population is spread throughout the country, the chances for forest fires are very great. When fires get established in these slash areas they present a very perplexing problem and often get under such momentum that great areas are destroyed before the fire is brought under control.

The State Forester believes that if the local forest wardens were given authority to consult with the lumbermen before the operation was begun, with a view of leaving some simple fire lines for future protection of adjoining properties, much good could be accomplished. This whole question is one of education. Up to the present little attention has been given the subject, and it is not uncommon to see the brush piled upon the line fence of the abutter, or even into the highway along country back roads. A wide-awake forest warden with a little authority could quickly get the co-operation of his people, and this would greatly lessen the present dangers. The ideal method of disposing of slash is to pile and burn it at once, but this is thought too expensive by many. The next thing is to spread the brush out thinly, so that it will quickly decay, and cut it up with belts or fire lines free of slash, so that should any portion catch fire it could be held within small areas.

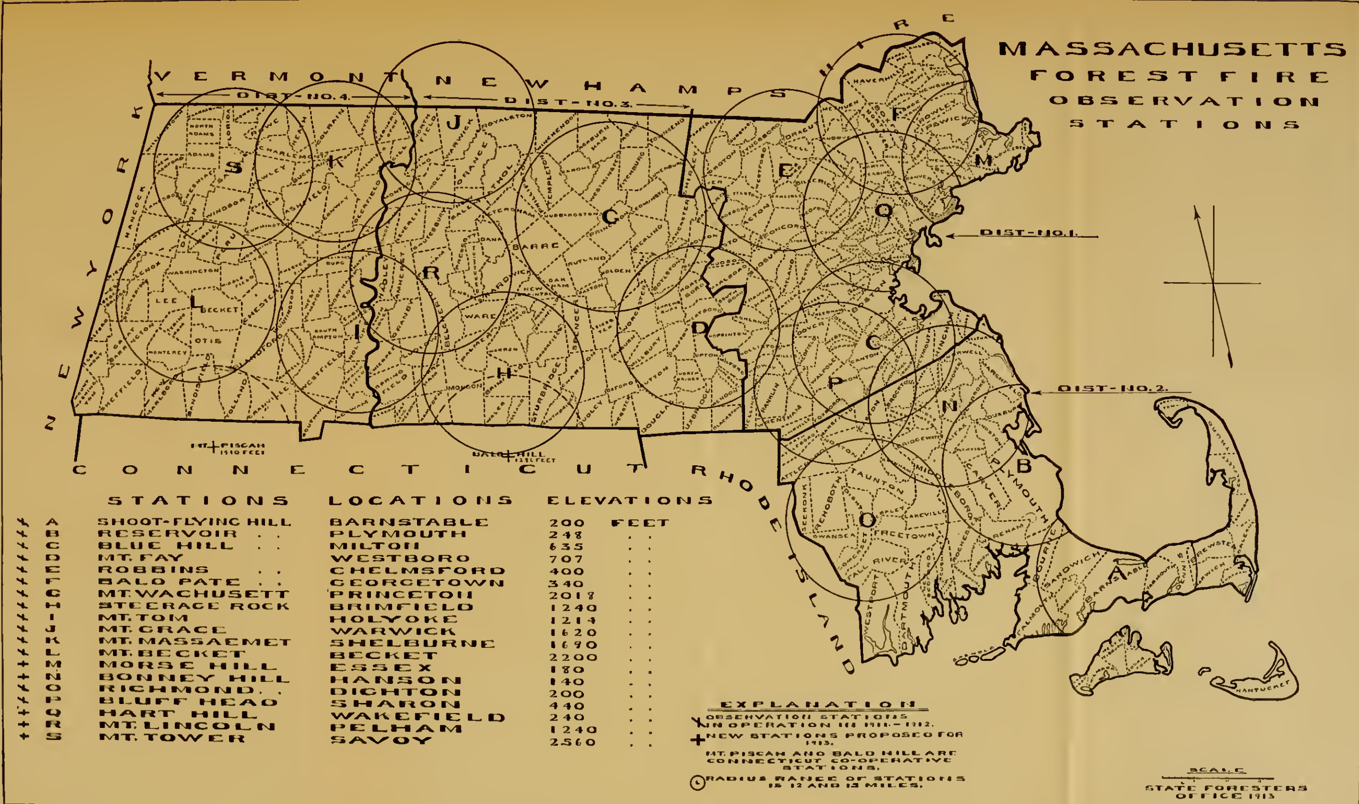
Report of the State Fire Warden.

Mr. F. W. Rane, *State Forester.*

Sir: — In compliance with your request I beg to submit the following report of the work accomplished by this branch of the department during the present year: —

The State has been divided into four forest fire districts, each district being in charge of an experienced and competent district forest warden, the district arrangement being as follows: District No. 1, Essex, Middlesex and Norfolk counties; District No. 2, Barnstable, Bristol and Plymouth counties; District No. 3, Worcester County and west to the Connecticut River; District No. 4, Berkshire County and east to the Connecticut River.

The principal work of the district forest wardens has been constructing telephone lines, erecting steel observation towers, map making, inspecting all forest fire-fighting equipment, visiting selectmen and forest wardens,



	STATIONS	LOCATIONS	ELEVATIONS
A	SHOOT-FLYING HILL	BARNSTABLE	200 FEET
B	RESERVOIR	PLYMOUTH	248 "
C	BLUE HILL	MILTON	635 "
D	MT. FAY	WESTBORO	707 "
E	ROBBINS	CHELMSFORD	400 "
F	BALD PATE	GEORGETOWN	340 "
G	MT. WACHUSETT	PRINCETON	2018 "
H	STEERAGE ROCK	BRIMFIELD	1240 "
I	MT. TOM	HOLYOKE	1214 "
J	MT. GRACE	WARWICK	1620 "
K	MT. MASSAEMET	SHELBURNE	1690 "
L	MT. BECKET	BECKET	2200 "
M	MORSE HILL	ESSEX	180 "
N	BONNEY HILL	HANSON	140 "
O	RICHMOND	DIGHTON	200 "
P	BLUFF HEAD	SHARON	440 "
Q	HART HILL	WAKEFIELD	240 "
R	MT. LINCOLN	PELHAM	1240 "
S	MT. TOWER	SAVOY	2560 "

and showing them the importance of appointing deputy forest wardens and having them distributed advantageously in the outlying timbered districts of the towns. This work has been very satisfactory, enabling us to have a large number of deputies appointed, which adds materially to the efficiency of the fire-fighting force of the department. In visiting the different towns our district forest wardens have taken especial pains to urge upon the selectmen and forest wardens the necessity of purchasing ample forest fire-fighting equipment. Each district forest warden has under his personal supervision practically 1,250,000 acres, 70 per cent. of which is forested or denuded lands. He also has supervision over the observation stations lying within his district.

We have had in operation this year 17 observation stations, each station covering practically 300,000 acres. They were placed in operation May 1 and were discontinued November 10.

District No. 1. — We have had in this district four observation stations. Blue Hill observatory at Milton covers the Blue Hill Reservation and a large area of adjoining forest land. Robbins Hill station in the town of Chelmsford covers a portion of the watersheds of the Concord and Merrimac rivers. At this station we erected a 30-foot steel tower with a 7-foot square room at the top. We also have a station at Bald Pate Hill, Georgetown, covering a portion of the North Shore and valuable forest land adjoining. At this station we erected a 30-foot steel tower with a 12-foot room at the top. The owner of Bald Pate Hill contributed one-half toward the purchase price and erection of the tower. We also have a station at Bluff Hill in the town of Sharon, covering the forest area to the Rhode Island line. At this station we have erected a 30-foot steel tower with an 8-foot square room at the top. We have established a temporary station at Wakefield on Castle Rock. This is used during dry and hazy weather, and has been under the supervision of the fire department of Wakefield. Negotiations are now being made to erect a steel tower on Hart Hill in Wakefield, one-half of the expenses to be borne by the town of Wakefield. This station will undoubtedly be established the coming year. Arrangements have been completed for the location of an observation station on Morse Hill on the Manchester and Essex line; a 40-foot tower will be erected and a telephone line completed in readiness for the spring work. This station will protect the valuable North Shore property. It is also necessary to establish a station on Nobscot Hill in the town of Framingham, to cover a large tract of territory that we are unable to reach from other stations. With these additional stations, to be established as substations, we shall be able to completely overlook all of District No. 1.

District No. 2. — In this district we have three stations in operation, — Reservoir Hill in Plymouth, Shoot Flying Hill in Barnstable and Richmond Hill in Dighton. At Plymouth we have had the use of the Plymouth observation tower, from which we have been able to cover the towns of Plymouth and Kingston, but I find that a station located on

Monks Hill in Kingston, which is one of the highest elevations in Plymouth County, would not only cover the territory now reached from the Plymouth tower, but would also cover a large tract west and south that we are unable to reach from Plymouth. It seems, therefore, advisable that this station be changed to Monks Hill, thus giving full protection to all the surrounding territory. At Richmond Hill we have been obliged to erect a 30-foot tower with an 8-foot room at the top. At Shoot Flying Hill we have added 10 feet to the tower that was already there, making an enclosed room for the observer. This station covers a large part of the Cape forest area. It will be necessary to establish a substation at Bourne and also one in the vicinity of Bridgewater or Hanson. These two stations, covering a territory that we are unable to reach from the stations now in operation, will practically complete the system in District No. 2.

District No. 3. — We have had five stations in operation in this district: Wachusett at Princeton, Fay Mountain at Westborough, Steerage Rock Mountain at Brimfield, Grace Mountain at Warwick and Lighthouse Hill at Prescott. This last-named station will be discontinued and a new station will probably be established on Lincoln Mountain in the town of Pelham, which will better protect this territory. Steel towers have been erected at Fay Mountain and at Steerage Rock Mountain this year. It will be necessary to establish two or three substations in this district to be used the coming year. The watersheds of the Blackstone, Chicopee, Miller, Nashua, Thames, Connecticut, Deerfield and Miller rivers are protected from these stations.

District No. 4. — In this district we have had four stations in operation. Mount Tom at Holyoke, where we have been allowed the use of the observation room at the Summit House, is an exceptionally good station, as we have the use of eighteen powerful telescopes. It will be necessary to install a private telephone line for use at this station the coming year. On Massaemet Mountain at Shelburne Falls we have been allowed the use of the 63-foot stone tower, and have enclosed the top with a 12-foot octagon building. We have had an observer on Greylock Mountain during a portion of the season, but owing to the high elevation of this station the results are far from satisfactory. We are not only unable to cover the Greylock Reservation, but we are also unable to cover the large area of forest land surrounding this range. I think it will be necessary, in order to cover this territory, to establish two stations, one on Tower Mountain, in the town of Savoy, which has an elevation of 2,500 feet and a second on a high point in the town of Williamstown, or, possibly, on Berlin Mountain, just over the New York line. In case a station is established on this last-named mountain it will be necessary that some co-operative agreement be made between the States of New York, Vermont and Massachusetts relative to the installation and maintenance of the same, as such a station will cover a large forest area in these two adjoining States. We have also had in operation a station on Becket Mountain in the town of Becket. Here it has been necessary to install a tele-

phone line and to erect a 30-foot steel tower with an enclosed room at the top. It will be necessary to establish two or three more substations in this district in order to properly protect the forest area and the watersheds of the Connecticut, Deerfield and Miller rivers. One of these stations will be located on October Mountain, covering the Whitney Preserve and the Pittsfield watershed.

The results obtained from the observation stations have been very satisfactory. While it has been absolutely impossible to detect every smoke, owing to the hazy and cloudy weather, at times making it impossible to see over 8 or 10 miles (although the observer is supposed to cover a radius of at least 15 miles), yet it is very gratifying to report that out of 1,800 fires reported by the different forest wardens over 1,500 were first observed by the men in charge of the observation stations. Of the fires reported by these observers our tables show that 51 per cent. were extinguished within one hour from the time they were observed, 21 per cent. within two hours, 15 per cent. within three hours, 5 per cent. within four hours, 3 per cent. within five hours, and that but 5 per cent. burned over five hours.

It seems necessary that there be established throughout the State more substations, to be used only during dry and hazy weather, when it is absolutely impossible to protect the territory by the permanent stations.

The triangulation system which was adopted this year has proved very effective in locating fires accurately at a distance of 12 or 15 miles. I feel confident that arrangements will be made the coming season for extending this system into the States of New Hampshire, Vermont and Connecticut, thus enabling us to get readings from their observation stations bordering on the north and south of this Commonwealth.

The towers with which we are equipping our stations are constructed for permanent use, being made of heavy steel, from 30 to 40 feet high. They are constructed with an 8 by 8 foot square building at the top, which has a glass enclosure as far as possible, thus allowing the observers to be continually on the watch and protecting them from inclement weather, as well as providing a suitable protection for our maps, report blanks, telephone and all necessary equipment. These towers cost complete, all constructed on cement piers, from $225 to $275, the variation in price being on account of difference in locality and expense of hauling. All construction work is done entirely by our district forest wardens and observation men, and I desire to say that we are extremely fortunate in having as district forest wardens men who are capable of handling this line of work as well as all map making and telephone construction work.

Forest Fire Equipment.

Under an act of the Legislature passed in the spring of 1910, appropriating $5,000 annually for forest fire prevention, all towns with a valuation of $1,500,000 or less are entitled to 50 per cent. reimbursement on all forest fire-fighting equipment they desire to purchase, not exceeding $500,

no town being allowed an amount exceeding $250. This equipment must be approved by the State Forester and placed under the supervision of the town forest warden subject to inspection at least once a month by the State Fire Warden or his duly authorized assistants. There are 172 towns in the Commonwealth which come within the provisions of this act, and owing to the fund not having been exhausted in the two previous years, a special effort was made early this season to interest towns in the necessity of taking advantage of the act, thereby better providing themselves with suitable equipment. The results have proved very satisfactory. Over 60 towns have filed their applications for reimbursement. The appropriation not being sufficient, but 45 towns were reimbursed, to the amount of $4,989.99. This exhausted the appropriation, and made it necessary to carry the balance of nearly $2,000 due other towns over to another year.

In selecting equipment several towns have purchased forest fire wagons complete with extinguishers and Marshfield cans, while other towns, not as favorably situated, have purchased a large number of extinguishers, distributing them among their deputies in the rural and timbered districts, each deputy being supplied with at least five extinguishers with necessary charges and water cans. This department holds receipts from the forest wardens for all equipment purchased under the reimbursement act.

There are 182 towns, with a valuation exceeding $1,500,000, which are not entitled to reimbursement. These towns are obliged to assume the total expense for whatever equipment they deem necessary. Several of them, seeing the necessity of improving their equipment, have purchased forest fire wagons and extinguishers, while other towns have purchased 30-horse power and 40-horse power motor trucks fully equipped for handling forest fires. Besides carrying the necessary equipment they are also able to carry from 20 to 30 men and make from 30 to 40 miles per hour. The towns of Plymouth, Hopedale, Winchendon, Rutland and Dover have purchased such trucks during the past year.

Our reports show the total amount expended for forest fire equipment this year throughout the Commonwealth to be $23,389.88. The following tables show, first, an itemized statement of the equipment purchased during the years 1910, 1911 and 1912 under the reimbursement act, and the amount received by each town from the Commonwealth during that period; second, a list of the towns having purchased equipment *this year*, and the amount of reimbursement received by them.

Railroad Fires.

I am pleased to report many improved conditions in the railroad fire situation. While there is no law in this State permitting inspection of locomotives by this department, through the courtesy of Mr. W. L. Larry, inspector for the Board of Railroad Commissioners, I accompanied him on several inspection trips covering a number of Boston & Albany, Boston & Maine, and New York, New Haven & Hartford locomotives. The

Forest fire observation tower, on Moose hill, Sharon.

Stevens Estate, Warwick (stand after thinning; logs on the ground).

conditions were practically the same on the different roads. Special attention had been given to the screens in the front ends, and they were found to be in exceptionally good condition, although instances were found where defective screens were in use. The chief cause of a large percentage of railroad fires seemed to be in not using necessary precaution in screening the ash pans and grates, and in allowing locomotives to operate with ash-pan slides open. Recommendations were made by the Board of Railroad Commissioners that rounded extensions or perforated plate or netting be used to close the opening between the mud ring and the top of the ash pan in the wide fire-box locomotives, and that in the flat type of ash pans perforated plate or netting be placed over the ends of ash pans, and that these nettings be securely hooked, and all openings for grate shaker levers be protected so that no fire could escape from the ash pans or grates. These improvements required several days' work on each locomotive. A report received from the Boston & Albany Railroad under date of Nov. 4, 1912, shows that they have in this State a main line mileage of 337 miles, and have in operation 356 locomotives, of which 300 have been repaired to comply with the requirements of the commission; 34 which do not comply with the requirements of the commission are still in operation, and 22 are in the shop and will be repaired before going into service. The necessary changes on the 34 above mentioned will be made during the winter.

Undoubtedly more work has been accomplished by the Boston & Maine than by any other road, when we take into consideration that they have a main line mileage of 1,200 miles and 800 locomotives in operation within this State. Owing to their loss by railroad fires last year exceeding $200,000, a department of fire claims and fire prevention was established early in March under the supervision of Mr. E. A. Ryder, and through his efforts their fire loss in this State does not exceed $15,000 this year. In July an appropriation of $30,000 was made for equipping their locomotives with an improved ash pan, and for screening the space above the mud ring. Up to the present time 255 locomotives have been placed in condition, and during the coming year a large percentage of the balance will receive the necessary repairs.

All inflammable material within their right of way has been removed or burned at different times throughout the season. Dangerous places adjoining their right of way have been cleared of slash and necessary fire lines have been built. A trench three feet wide is made around each pile of ties before burning.

Special effort has been made to better train their engineers in the handling of their locomotives, endeavoring to do away with the "slipping" of engines, which has a tendency to churn the fire and cause sparks to be emitted from the stack.

The officials of this road have placed in all smoking, baggage, express, mail and caboose cars signs reading: "Save the forests. Do not throw lighted matches, cigars or cigarettes from the cars." These signs should

be placed in all cars of such nature, and in all electric cars running through forest lands throughout the State.

We experienced considerable trouble early in the season with the Central Vermont Railroad, and an inspection of their locomotives was made, with the result that nearly all of them were found in some way defective. As they had but 29 locomotives in operation throughout the Commonwealth, these were repaired and placed in very good condition within thirty days, and we experienced very little trouble with them during the remainder of the season.

Up to the present time I have been unable to procure a detailed statement from the New York, New Haven & Hartford Railroad giving a summary of what they have done in the matter of fire prevention. I understand, however, that they have 781 locomotives in operation in this State, 60 of which have been equipped with what is called the "Talmage" ash pan, which absolutely prevents the escape of coals from this source. The balance of their locomotives are being equipped at the rate of 60 each month, so that by another season a large percentage of their locomotives should be in excellent condition. The results obtained by the New York, New Haven & Hartford have not been entirely satisfactory, and I think this can be attributed to two reasons: first, it has taken considerable time to perfect an ash pan suitable for their type of locomotives, thus allowing the use of their locomotives all summer with the old ash pans; second, they still hold to their old policy of preferring to settle fire claims rather than to devote more time to ascertaining the causes of their fires and then applying preventive methods. Much better results will be obtained from this road another year.

Our railroad fire reports show that we have had 640 railroad fires, as follows: New York, New Haven & Hartford, 353; Boston & Albany, 117; Boston & Maine, 146; Central Vermont, 24; burning over an area of 5,771 acres, with a cost to extinguish of $5,530 and a damage of $27,955. During the year 1911 we had 685 railroad fires, burning over 29,842 acres and causing a damage of $330,389.50. A comparison shows that, while we had nearly as many fires this year from this source, owing to the efficient work done by the railroad officials, together with the assistance derived from our observation stations and town forest wardens, the fires were extinguished without causing the serious losses of previous years.

Railroad officials claim that an inspection is made once a week of the screens in the front ends of all locomotives operating in this State, and that once a day the ash pans and grate protections are examined, showing that at the time any locomotive leaves the roundhouse or yard it is in perfect condition.

A large number of dangerous railroad fires would be prevented if property owners whose lands adjoin a railroad's right of way would devote a little time and money to removing or burning the inflammable material within 50 or 100 feet of the right of way. The same condition arises along highways running parallel with railroads and within a few feet of them when brush is allowed to accumulate.

Rural Mail Carriers.

The Postmaster-General, under date of May 31, 1912, issued an order requiring all rural mail carriers to promptly report all forest and brush fires to the nearest forest warden or deputy forest warden. We have within the Commonwealth of Massachusetts 300 rural and star route carriers, with routes averaging about 20 miles, thus giving us a patrol route of practically 6,000 miles that is traveled each day, with the exception of Sundays and national holidays. As soon as the above order became effective each carrier was supplied with a list of wardens and deputies, together with their telephone numbers and places of residence, in order that all fires observed by them could be promptly reported and extinguished.

An investigation shows that, owing to this branch of the work being entirely new, there are a large number of routes with no forest wardens or deputies residing on them; therefore it is necessary that our district wardens, in connection with the different town forest wardens, go over each route and have necessary deputies appointed residing in or near the forest areas and dangerous fire localities and having telephone connection. This work I believe will be completed during the coming winter in order that we may be in readiness for spring fires. The work accomplished by the carriers this season has been very effective. Our reports show 84 fires observed and reported, besides several fires extinguished in their incipiency by the carriers.

Federal Co-operation.

The Weeks bill, passed in 1910, providing for the purchase of portions of the White Mountain and Appalachian Mountain regions, to be held as government reservations, also carried an appropriation of $200,000 for the protection against forest fires of the watersheds of navigable streams in the United States. Of this appropriation $2,500 was allotted to the State of Massachusetts, to be expended in co-operative effort in such sections of the Commonwealth as would properly come within the provisions of the bill. This restricted our co-operative work to the western portion of the State, including the watersheds of the Nashua, Chicopee, Miller, Thames, Blackstone, Hudson, Connecticut and Deerfield rivers. This allotment became available May 1, and was used for the payment of federal observation men who were placed in charge of the 9 observation stations west of the east line of Worcester County, this being the territory coming within the co-operative agreement. Of the amount appropriated, $2,477 was expended in this work. Owing to the State appropriation not being sufficient to carry on the work mapped out throughout the State, this government aid has been very necessary, permitting us to expend a portion of our State allotment in the construction of observation stations and telephone lines, as under the terms of the agreement with the United States government the State is required to expend an amount equal to that expended by the federal authorities in protecting the above-

named territory. Owing to its being necessary to establish more observation stations within this territory in order to better protect the watersheds of these rivers, it is necessary that our federal appropriation be increased to at least $3,500 for the coming year.

Boy Scouts.

We have within the Commonwealth of Massachusetts 7,000 boy scouts. These are divided into 250 separate companies, each company being in charge of a scout master or assistant scout master. As soon as the fire season started in the spring we supplied each scout master and assistant with a copy of the fire law and instruction book, thus enabling them to instruct the members of the different companies relative to the forest laws.

The reports received do not show that the boy scouts have been instrumental in causing a single fire, but do show that they have extinguished several brush fires and have patrolled the railroad right of way in different localities, extinguishing fires, and it is but fair to assume that the educational work done through the scout masters has resulted in the prevention of many fires. When necessary to have camp fires they have always complied with the law by applying to the town forest warden for the necessary permit, the same being granted when weather conditions were favorable.

Prosecutions and Convictions.

Under section 2, chapter 244 of the Acts of 1911 every forest warden or deputy forest warden is vested with authority to arrest, without a warrant any person in the act of setting or maintaining a fire in violation of the law. To the average person this may seem a very easy matter, but owing to the fact that a party must be caught in the act of setting or maintaining a fire in order to arrest and take him before a magistrate having jurisdiction in such cases, it is possible to get but a small percentage of the violators. Reports show that 16 parties have been convicted for violating the fire law during the season; also that several parties have been allowed to settle by paying to the selectmen an amount equal to the cost of extinguishment. Owing to the permit law which governs all forest or brush fires, having been in operation but two years, I have not been in favor of enforcing the law too severely by recommending arrest in every instance of violation, but have endeavored, in cases where parties were unfamiliar with the laws and had violated them unknowingly, to arrive at some satisfactory settlement.

Deputy Fish and Game Commissioners.

It is gratifying to report the efficient forest fire work accomplished by the deputy fish and game commissioners of the State. While their duties are confined, in general, to the protection of the fish and game, section 299 of the Acts of 1907 also gives them authority to arrest without warrant any person found in the act of unlawfully setting a fire, and under section 20, Revised Laws, they have power to summon necessary assist-

ance to extinguish fires, which gives them the same powers and duties as are vested in a town forest warden except that they do not have authority to issue permits. They were supplied with copies of the forest fire laws early in the season, and their names were placed on our observation list, together with their addresses and telephone numbers. The observers were instructed to call them only when necessary. The reports received at this office show that they have been instrumental in extinguishing nearly 100 fires. I believe that in future years marked results will be shown by the co-operation with the fish and game deputies during severe droughts.

Precipitation, in Inches, for the Years 1910, 1911 and 1912, with December of Previous Year.

Months.	1910.	1911.	1912.	Normal.
December,	3.80	3.24	2.59	3.74
January,	4.89	3.07	3.87	4.12
February,	4.03	3.20	2.24	3.97
March,	1.77	3.27	5.26	4.34
April,	2.64	2.86	4.05	3.46
May,	1.60	0.89	4.03	3.37
June,	3.97	4.76	0.53	3.07
July,	2.41	4.55	4.16	3.65
August,	1.05	6.70	3.85	3.70
September,	2.29	3.36	1.71	4.36
October,	1.64	3.01	1.52	4.13
November,	5.39	5.71	3.45	3.96
Totals,	35.48	44.62	37.26	45.87

Table showing Percentage of Fires occurring at Different Hours of the Day.

Time.	Per Cent.	Time.	Per Cent.
7 to 8 A.M.,	1.0	1 to 2 P.M.,	16.0
8 to 9 A.M.,	3.0	2 to 3 P.M.,	14.5
9 to 10 A.M.,	9.0	3 to 4 P.M.,	10.0
10 to 11 A.M.,	8.0	4 to 5 P.M.,	9.0
11 to 12 M.,	13.0	5 to 6 P.M.,	7.0
12 to 1 P.M.,	7.0	6 to 7 P.M.,	2.0

Comparative Damages by Forest Fires for the Past Five Years.

Year.	Number of Fires.	Acreage burned.	Cost to extinguish.	Damage.	Average Acreage per Fire.	Average Damage per Fire.
1908,	1,289	39,672	-	$205,152	30 78	$159 15
1909,	1,496	35,083	-	189,482	23.45	126 66
1910,	1,385	42,221	$23,475	205,383	30 46	148 29
1911,	2,536	99,693	47,093	537,749	39.31	226 24
1912,	1,851	22,072	20,219	80,831	11.92	43 67

Forest Fires of 1912.

Months.	Acres.	Damage.	Cost to extinguish.	Number.
1911.				
December,	97	$42	$134	55
1912.				
January,	20	435	476	33
February,	5	-	7	20
March,	428	777	360	117
April,	4,756	8,884	2,223	408
May,	3,556	16,800	2,636	318
June,	1,797	12,108	2,167	181
July,	2,748	10,772	4,616	258
August,	123	444	174	28
September,	85	150	86	15
October,	7,835	28,387	6,806	358
November,	622	2,035	527	60
Totals,	22,072	$80,834	$20,212	1,851

Comparative Causes of Forest Fires for the Past Three Years.

Causes.	1910.		1911.		1912.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Unknown,	413	32.9	1,128	44 5	649	35.1
Railroad,	362	28.8	685	27.0	640	34.6
Burning brush,	203	16 2	135	5.3	93	5.0
Smokers, hunters, berry pickers,	124	9.9	158	6.2	223	12.0
Steam sawmills,	1	.1	3	.1	8	.4
Children,	75	5.9	118	4.7	79	4.3
Miscellaneous,	78	6.2	309	12.2	159	8.6
Too late for tabulation,	129	-	-	-	-	-
Totals,	1,385	100.0	2,536	100.0	1,851	100.0

INVENTORY OF EQUIPMENT PURCHASED UNDER THE REIMBURSEMENT ACT.

Town.	Axes.	Cans.	Extings.	Hoes.	Lanterns.	Mattocks.	Pails.	Pumps.	Rakes.	Shovels.	Wagons.	Reimbursement.
Acushnet,	1	10	116	–	–	–	4	1	–	–	1[1]	$143 22
Ashby,	–	–	12	–	–	–	–	–	–	–	–	34 50
Ashland,	–	–	6	–	–	–	12	6	–	6	–	43 27
Auburn,	–	–	70	–	–	–	–	–	–	–	–	210 00
Avon,	–	10	–	–	–	–	12	–	–	–	–	9 90
Bedford,	1	14	21	–	–	–	–	–	–	–	1[2]	249 67
Belchertown,	–	–	6	–	–	–	–	–	–	–	1	71 62
Bellingham,	–	10	20	–	–	–	–	–	–	6	–	67 22
Berkley,	–	–	14	–	–	–	–	–	–	–	–	144 00
Berlin,	2	10	38	–	–	1	12	–	3	12	1[1]	241 45
Blandford,	–	1	16	–	–	–	–	–	–	–	–	59 80
Bolton,	–	14	12	–	–	–	6	–	–	6	–	58 40
Boxborough,	–	–	30	–	–	–	–	–	–	–	–	90 00
Boxford,	–	–	16	–	–	–	–	–	–	–	–	45 60
Boylston,	–	–	24	–	–	–	–	–	–	–	–	76 20
Brimfield,	–	10	30	–	–	–	–	–	–	–	–	99 75
Carlisle,	2	15	10	–	2	–	6	–	1	6	1[1]	193 72
Charlton,	–	–	68	–	–	–	40	–	–	60	–	221 37
Chatham,	2	15	10	–	2	3	4	–	3	5	1[1]	152 98
Dighton,	2	8	18	–	1	–	–	–	2	2	1[1]	108 67
Douglas,	–	25	50	–	–	–	–	–	–	–	–	175 00
Erving,	–	–	25	30	–	–	–	–	–	18	–	86 52
Freetown,	–	24	8	–	–	–	2	–	–	48	–	87 62
Georgetown,	–	20	24	–	–	–	–	–	6	12	–	98 83
Gill,	–	5	20	–	–	–	–	–	–	–	–	65 00
Greenwich,	–	–	18	–	–	–	–	–	–	–	–	60 45
Groveland,	–	6	12	–	–	–	–	–	3	12	–	51 05
Hadley,	–	–	15	–	–	–	–	–	–	–	–	75 00
Halifax,	–	12	52	–	–	–	12	–	–	18	–	205 91
Hanson,	–	6	24	–	6	–	6	–	–	5	1[3]	250 00
Harvard,	2	7	14	–	2	3	–	–	3	12	–	201 52
Holbrook,	–	12	10	–	–	–	–	–	–	–	–	69 00
Lunenburg,	2	12	10	–	2	3	4	–	3	5	1[1]	149 28
Lynnfield,	–	10	20	–	–	–	–	10	–	–	2[2]	246 25
Mashpee,	–	–	8	–	–	–	–	–	–	12	–	34 55

[1] One-horse. [2] Two-horse. [3] Motor Truck.

Inventory of Equipment purchased under the Reimbursement Act — *Continued.*

Town.	Axes.	Cans.	Extings.	Hoes.	Lanterns.	Mattocks.	Pails.	Pumps.	Rakes.	Shovels.	Wagons.	Reimbursement.
Merrimac,	–	–	15	–	–	–	–	–	–	–	–	$75 00
Middleton,	–	–	16	–	–	–	–	–	–	–	–	49 50
New Braintree,	–	–	25	–	–	–	–	–	–	–	–	76 87
Newbury,	–	–	6	–	–	–	–	–	–	–	–	18 15
North Reading,	–	–	–	–	–	–	–	–	–	–	1[1]	134 43
Northborough,	–	–	25	–	–	–	–	–	–	–	–	102 37
Norwell,	–	–	32	–	–	–	12	–	–	–	1[1]	243 87
Oakham,	–	–	24	–	–	–	–	–	–	–	–	138 00
Pelham,	–	–	19	–	–	–	–	2	–	–	–	76 62
Pembroke,	–	–	24	–	–	–	–	–	–	–	1[2]	203 75
Petersham,	2	10	22	–	2	3	4	–	3	5	1[1]	202 55
Phillipston,	–	6	14	–	–	–	–	–	–	–	–	48 65
Plainville,	2	10	10	–	2	3	4	–	3	5	1[1]	178 50
Prescott,	–	–	10	–	–	–	–	–	–	–	–	48 16
Princeton,	–	32	80	–	–	–	–	–	–	–	–	249 20
Raynham,	3	46	30	–	6	–	12	–	9	15	3[1]	222 23
Rehoboth,	–	10	48	–	–	–	–	–	–	–	1[1]	250 00
Richmond,	–	15	15	–	–	–	4	–	–	–	–	56 20
Royalston,	3	10	15	30	2	2	12	–	–	30	1[1]	120 60
Rutland,	–	12	18	–	–	–	6	–	–	–	1[3]	250 00
Sandwich,	22	12	36	–	–	2	–	–	–	24	1[1]	245 60
Shelburne,	–	–	50	–	–	–	–	–	12	6	1[1]	186 87
Shirley,	–	48	36	–	–	–	–	–	–	–	–	139 50
Shutesbury,	–	16	25	–	–	–	–	–	–	–	–	87 50
Sterling,	–	–	25	–	–	–	–	–	–	–	1[2]	231 75
Stow,	–	–	42	–	–	–	–	–	–	18	–	131 31
Sturbridge,	–	11	35	–	–	–	–	–	–	–	–	116 45
Sudbury,	–	–	40	–	–	–	–	–	–	–	–	250 00
Sutton,	–	50	50	24	–	–	–	–	32	24	–	188 46
Tewksbury,	2	–	24	–	2	–	–	–	–	30	1[1]	174 00
Tyngsborough,	–	120	20	–	–	–	–	30	12	24	–	189 80
Upton,	–	–	18	–	–	–	–	–	–	–	–	128 53
Wales,	2	10	40	–	2	2	–	–	–	–	1[1]	236 77
Wendell,	–	–	8	–	–	–	–	–	–	12	–	35 07
West Bridgewater,	–	–	20	–	–	–	–	–	–	–	1[1]	200 12

[1] One-horse. [2] Two-horse. [3] Motor Truck.

INVENTORY OF EQUIPMENT PURCHASED UNDER THE REIMBURSEMENT ACT — *Concluded.*

Town.	Axes.	Cans.	Extings.	Hoes.	Lanterns.	Mattocks.	Pails.	Pumps.	Rakes.	Shovels.	Wagons.	Reimbursement.
West Newbury,	–	10	6	–	–	–	–	–	–	–	–	$33 75
Westminster,	–	52	48	24	–	–	24	–	–	24	–	242 22
Wilbraham,	–	–	23	–	–	–	–	–	–	–	–	136 31
Wilmington,	–	12	40	–	1	–	–	18	–	34	–	137 38
Windsor,	–	–	30	–	–	–	–	–	–	–	–	150 00
Wrentham,	–	12	12	–	4	–	–	–	–	–	1[1]	210 10

[1] One-horse.

TOWNS RECEIVING FIRE-EQUIPMENT REIMBURSEMENT DURING YEAR 1912.

Acushnet,	$143 22
Ashby,	34 50
Auburn,	210 00
Avon,	9 90
Bedford,	28 75
Bellingham,	67 22
Berkley,	144 00
Berlin,	241 45
Blandford,	59 80
Boxborough,	90 00
Boylston,	76 20
Brimfield,	99 75
Chatham,	6 45
Dighton,	50 00
Erving,	75 00
Freetown,	72 62
Georgetown,	43 50
Gill,	65 00
Greenwich,	34 50
Halifax,	205 91
Harvard,	201 52
Holbrook,	24 00
Lynnfield,	86 25
Merrimac,	75 00
New Braintree,	$76 87
Norwell,	193 87
Pelham,	36 00
Petersham,	202 55
Raynham,	172 23
Rehoboth,	250 00
Richmond,	56 20
Royalston,	98 25
Rutland,	250 00
Shelburne,	4 37
Shirley,	139 50
Stow,	131 31
Sturbridge,	116 45
Sutton,	188 46
Wales,	236 77
Westminster,	186 31
Wilmington,	146 21
Windsor,	150 00
Wrentham,	210 10
Total,	$4,989 99
Unexpended balance,	10 01
Total appropriation,	$5,000 00

While the work of this branch of the department has progressed fairly well, it is by no means up to the standard. It is necessary that we have at least twelve substations in order to completely cover the State during hazy and smoky weather. We must have better fire-fighting organizations in many of the towns. Our forest wardens and their deputies must be men who have the faculty of handling men; they must be experienced in fighting forest fires; they should have telephone communication, so that observers can get them promptly in case of fire. Nearly all forest wardens are paid only while actually employed, and in ordinary years this means a very small remuneration. In order to secure good, desirable, efficient men they must be paid. The type of man needed has the ability

and energy to make more in some occupation, and he cannot afford to give his services or neglect his business at times for a few days' work. There are cases where men are doing such service because of their interest in the forests, but there is no good reason why a capable forest warden should not be paid as generously as any town officer.

Forest wardens should be provided with modern fire-fighting equipment. At least one-half of the towns within this Commonwealth have no equipment whatever for handling fires, and until the selectmen and residents of such towns provide their wardens with suitable equipment, just so long will they have disastrous fires. City fire departments that have an appropriation covering only their building and city fires should not be obliged to expend a large part of this fund in fighting forest fires, but a special fund should be available for such fires, and in many cities the city fire department should have jurisdiction only within the city limits. A town forest warden should be appointed who should have jurisdiction over all fires outside the city limits, and he should be supplied with the most modern equipment. In this way we shall accomplish results. Some of the most serious and damaging forest fires we have had this summer have come under the supervision of city fire departments, and were absolutely uncared for.

Another trouble we have experienced is in fires occurring just over the town line. There should be no town lines in fighting forest fires.

Through the courtesy of Mr. L. A. Wells, observer in charge of the meteorological observatory at the Blue Hill Reservation, we are able to submit a table showing the precipitation for the years 1910, 1911 and 1912, and also the normal rainfall (see page 311). This table shows that the rainfall for 1912 is 7.36 inches less than in 1911 and 8.61 inches less than normal. It shows that during the months of March, April, May, July and August the precipitation was above normal, but the rainfall in June was 2.54 inches below normal, there being but .53 of an inch rainfall that month. During the months of September and October, the time when our dangerous fires are liable to occur owing to the leaf fall and to frosts that kill the vegetation, the rainfall was 2.61 inches below normal. Taking into consideration the scantiness of the rainfall and the fact that the majority of the observers are new to the work, we feel that the results obtained have been very gratifying.

Detailed reports received from the town forest wardens show that we have, in addition to the forest wardens in the different towns, 1,640 deputy forest wardens, 1,135 of whom have telephone communication with the observation stations. These reports show that our wardens have issued 16,851 permits for burning brush, fallow, etc. We have 317 portable sawmills in operation throughout the State, of which 61 are in operation in District 1, 22 in District 2, 137 in District 3, and 97 in District 4.

Statistics show that over 350,000,000 feet of lumber are being cut in Massachusetts annually. This, in addition to what is being used for railroad ties and in wood-using industries, will soon exhaust all merchantable

timber within the Commonwealth unless some drastic measures are adopted prohibiting the wholesale cutting of the same. It is not only a matter of removing the merchantable timber, but nearly every party carrying on lumbering operations leaves a dangerous fire slash which at some future time is sure to cause a disastrous fire. These slashes could be prevented and the fire danger lessened very materially if a slash law were enacted making it necessary that all such slash be removed or burned. Legislation should be enacted compelling the screening of all portable steam mills, donkey engines, steam rollers, steam shovels and all other coal-burning boilers and locomotives that are in operation in or through forest areas.

The comparative table on page 312 shows acreage burned, cost to extinguish and damage caused by forest fires throughout the Commonwealth for the past five years. While the loss has been reduced from $537,749 for the year 1911 to $80,836 for the present year, it is still greater than it would have been provided we had had efficient fire fighting in every town. With the exception of a very few fires, the principal damage was caused by not leaving sufficient help at the fires after they were supposed to be under control. Many fires were left at night uncared for, only to be sighted by the observer the following day, and before sufficient help could be procured the fire was again beyond control. Again, we lost heavily in the practice of back-firing, which seems to be the only means that some wardens have of handling fires. This is absolutely uncalled for unless in the case of a crown fire. As long as a fire is confined to the ground there is no sufficient reason why it cannot be extinguished without back-firing.

Nearly all our serious fires were confined to the eastern part of the State. We had no serious fires west of Worcester County, and the Cape country was without any damaging fires, as compared with previous years. The principal cause of fires in the Cape country in the past has been the use of defective locomotives. An effort has been made this season to overcome this trouble, special attention having been given to all locomotives running through the Cape country, with the result that very few fires have been started from this source.

The comparative table on page 312 shows that our losses were held very low until we experienced the severe drought during the month of October. While the month of June was exceptionally dry, with only .53 of an inch rainfall, our loss was held down to practically $12,000. The most serious fires occurred between October 15 and October 23. On Sunday, October 20, we had 51 fires burning in nearly as many towns, this being the record day of the season. These fires were confined to Norfolk and Plymouth counties.

We have been extremely fortunate this year in obtaining reports of fires. We have been able to have reports of practically every fire that caused any damage of importance. This is undoubtedly due in a measure to a small fee we have allowed each warden for such reports. As is indicated by the table on page 312 these reports show that 35.1 per cent. of all the fires reported to this office were of unknown origin. Many of these were undoubtedly caused by people traveling along highways and through

the forests and carelessly tossing away lighted matches, cigar butts or cigarette stubs. Cleaning up the inflammable material along the highways would eliminate a large number of fires from this source. Although the percentage of unknown fires is less than last year, it is by no means satisfactory. Each town should pay its forest warden a suitable salary, so that he can afford to make a careful examination regarding the circumstances attending each forest fire in his territory.

Railroads still head the list in the percentage of known causes. It will be observed that the percentage of railroad fires has increased considerably over the figures for last season, but this is explained by the decreased percentage of "unknown" and "miscellaneous" fires. The total number of railroad fires is slightly less than last season.

Early in the spring this office distributed to the forest wardens throughout the State 12,000 cloth posters on which were printed extracts from the Massachusetts forest fire laws. These were posted in conspicuous places in the forest area of the different towns. Notwithstanding this extensive posting of the fire laws the table shows an increase in the number of fires caused by hunters, smokers or berry pickers, indicating an attitude of carelessness on the part of the general public which must be combated by educational work and by a more active prosecution of offenders.

Reports show the present permit law, which has been in operation for the past two years in over 220 towns and cities throughout the Commonwealth, to have given general satisfaction. This law applies to all cities and to such towns as have accepted it at any annual or special town meeting. Our reports also show that 16,851 permits have been issued this year, and that the percentage of fires caused by burning brush, etc., has been reduced from 16.2 per cent. in 1910 to 5 per cent. this year, which is without doubt due to the enforcement of this law. There being less than 25 towns that have not accepted the act, it seems necessary that legislation be enacted making this law uniform throughout the State, thus eliminating the considerable dissatisfaction which has arisen in some parts of the State over the unequal application of the law.

The law relative to the appointment of forest wardens should be amended, allowing the appointment of such forest wardens to be made in January each year instead of in March or April, as it now is. Inasmuch as our fire season is at hand the first of March in ordinary years, the appointment of our men coming at that time allows us no opportunity whatever for perfecting our organization and instructing any new men who may be appointed. We are also unable to have a correct list of all forest wardens and their deputies for the use of our observation men until after the fire season is well advanced. By allowing the mayors and selectmen to make their appointments in January, we would have sufficient time to complete our organization and be in readiness for handling spring fires.

I am very much in favor of legislation being enacted this winter allowing the State to assume one-half the expense of fighting forest and brush

fires in all towns with a valuation of less than $2,000,000. While this means an additional appropriation by the State of from $7,000 to $10,000 each year, I feel that the results obtained would fully justify the expenditure.

It is needless to point out the value of the forests of a State to the people of that State as a whole, as distinguished from the citizens of the separate towns, for in many cases the products of these woodlands are not consumed within the towns themselves wherein they grow, but are used directly by the cities which have no forest area. This being the case, the welfare of the forest should be the interest of every citizen in the Commonwealth. In view of this, one of the chief defects of our present method of protecting the forests has been that we have left it wholly in the hands of the individual towns, without responsibility to any single head. This defect, of course, has been partly remedied by the organization of this branch of the department, and the benefits resulting therefrom are, we believe, already apparent. In many ways, however, the hands of the State Fire Warden, working through his deputies, are still tied, for while it is possible for him to devise many ways wherein towns may co-operate with each other and with his deputies, it is often impossible to properly carry out these plans because of the inability of the State under the present law to guarantee any substantial remuneration. Any business man will realize the futility of expecting satisfactory service for nothing, and the case of the State does not differ; in fact, we are constantly surprised at the amount of time and labor that have been given gratis in the past by our wardens. The zeal of a few wardens, however, cannot offset the carelessness of many. Furthermore, unpaid labor is usually spasmodic, and for these reasons the efficiency of the service as a whole deteriorates rather than increases under such a system.

It will be necessary to mention only a few ways in which the control established under a system of part payment of fire-fighting expenses by the Commonwealth would increase the efficiency of the fire-fighting service. A uniform rate of pay for all fire fighters could be put into effect, thus doing away with the disadvantage of having a difference in wage of from 10 to 20 cents an hour in adjoining towns, a condition which now exists and which has produced much discontent and inefficiency. Again, it would be possible to pay the local warden in each town an amount in some degree commensurate with his services, a state of affairs which does not now obtain in many cases.

The number of towns covered by the plan outlined above would be 194, as against the 172 covered under the present fire-equipment act, which is limited to towns having a valuation of $1,500,000 or less; and it is to be especially noted that the area occupied by these 194 towns comprises 80 per cent. of the woodland area of the State. That such a proposition is not an experiment is borne out by the fact that nearly all the eastern States are working under similar laws under which the State pays a fixed proportion of the fire-fighting cost (in most cases one-half), and thereby

obtains a better grade of men and of work than was formerly possible. That such results would be obtained here cannot be doubted, especially in view of the success of the present reimbursement act elsewhere referred to.

Aside from the above financial considerations, the value of our woodlands in other ways makes their protection imperative. No forester, and, for that matter, no person of ordinary powers of observation who has given any thought to the subject, can doubt the value of woodland as a retainer of the soil, a regulator of the stream flow, a cover for game, and a pleasure resort for the people. For these reasons alone, if the timber had no financial value, the woodland should be preserved. This has been said so many times as perhaps to weaken its force, but the observer need only look at such countries as France and China to be convinced of its truth; and the time is coming, and it is not far distant, when the people of the State will learn to use the woodland more and more as a place of recreation, as is the custom in foreign countries like Germany, where the tired city dweller takes his family with him to spend his holiday in the woods, and returns invigorated and refreshed.

Respectfully submitted,

M. C. Hutchins,
State Fire Warden.

Boston, Mass., Nov. 30, 1912.

Suggested Changes in Tree Warden Law.

The time is here, it is believed, when our cities and towns can ill afford not to have a trained man in their employ who has a practical working knowledge of forestry. We have been improving our conditions year by year. The old fire ward plan has been changed to the present forest warden system, and the local moth superintendents' work has been systematized so that it is improving each year. It now remains to readjust our tree warden law so that a trained man may be appointed who will be held responsible for getting results. There is no intention of casting any reflection upon the present tree wardens, as they have in most cases had little or no money to do with, and towns and cities have shown indifference to the position. There is also confusion in the minds of many between the duties of forest warden, moth superintendent and tree warden, which is perfectly natural. Many towns feel that the tree warden, by virtue of his election, must have the moth work to superintend, regardless of whether he has abilities in that direction or not. These misunderstandings have been unfortunate, for in order to get best results the work should not only be well done but should also

A hardwood growth that has been thinned and treated for gypsy and brown-tail moths. Note how white pine has seeded in. This is an example of how pine can be encouraged to supplant other species. Pickman estate, New Bedford.

A view of a road through North Shore woodland where the hardwoods have been cut out to eliminate the ravages of the gypsy moth.

run smoothly. The very fact that the tree warden is an elective office, and that there is frequent rivalry for the place, engenders feelings that are in themselves antagonistic. The reason that the forest warden work is advancing so well and with so little friction is that the office is not in politics, but depends on merit. This is equally true of the work of the moth superintendent. Were we to make the tree warden also appointive by the selectmen instead of elective, there is every reason to believe that the whole forestry plan would result in better work and at less expense. There would be a tendency to amalgamate the three positions into one. This could be done now only that it often happens that the tree warden who is elected is not a man sufficiently experienced to get results. The three town offices are each of importance, but if properly systematized the work could be planned so that one well-trained man could handle all. The setting out and pruning of trees could be done at a time of the year when there is little to be done on moth work, and hence the two kinds of work, if combined, would give continuous employment, and naturally interest a more stable and efficient class of employees. These same men, being in steady employ, could be utilized as the active force for fighting forest fires or brush. With the work thus systematized I am confident our future conditions will be far more satisfactory.

Gypsy and Brown-tail Moth Suppression.

The moth work has gone forward in a definite and systematic way and we have every reason to feel encouraged by the results. As stated under another heading, the State Forester is frank to say that the sooner we adopt scientific forestry methods just so soon will we take a forward step in their control. Ever since the work of moth suppression came under the control of this department it has been our constant aim to utilize forestry principles in combination with the other practices employed as the most effective method of getting results.

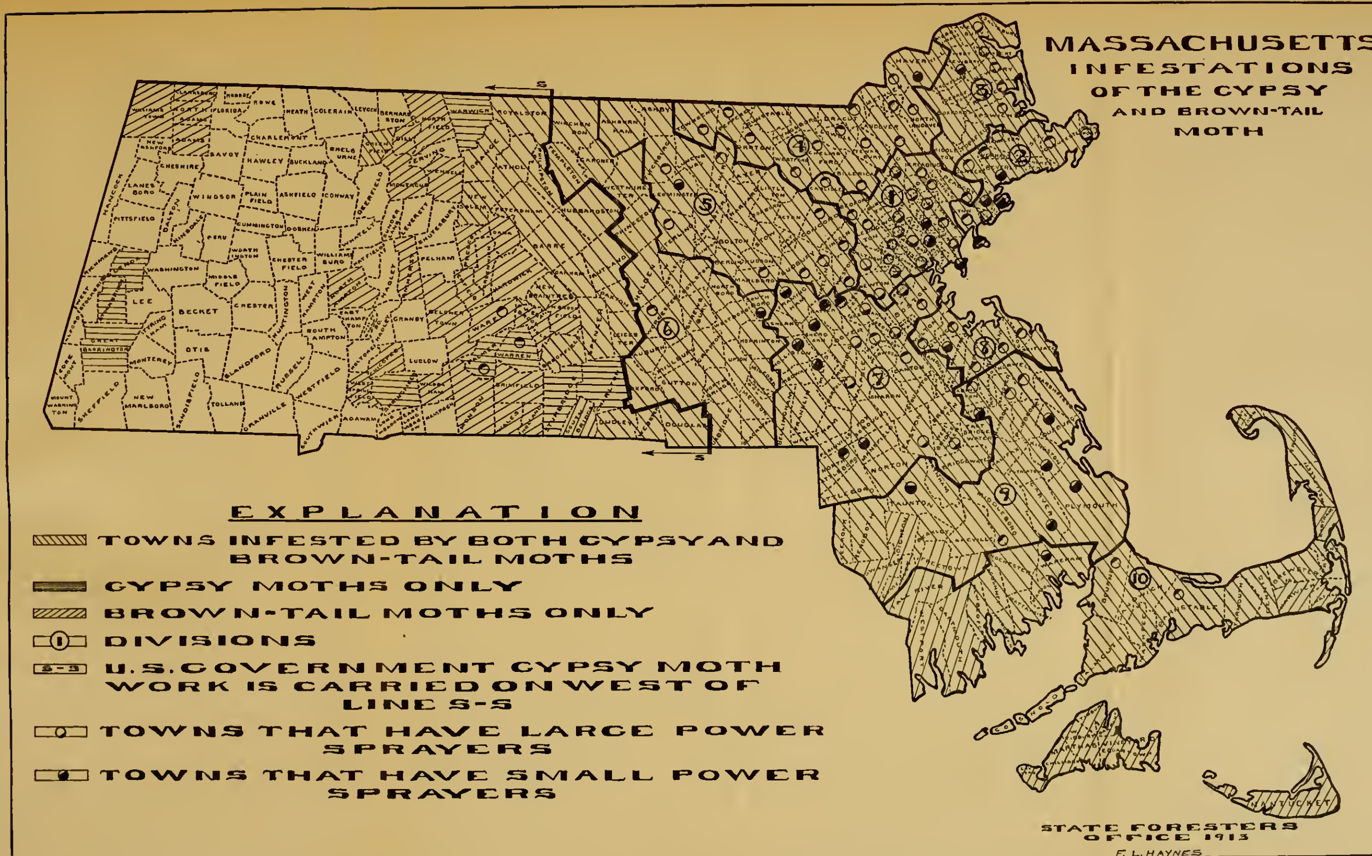
In the earlier days the moth problem was more confined to residential sections, and hence to parks, shade trees and shrubbery, and the methods of combating it were quite different from those at present in use. The insects now have spread out into the country, and the problem is one of fighting them under much more adverse conditions. Under city and village conditions

property is worth more and people are willing to expend more money to protect it; but when the moths spread out into the back wood lands, much of which is of extremely indifferent growth and in many instances comparatively worthless, the problem is quite different. The State law which gives protection in residential sections, requiring all property owners to pay in proportion to their valuation, ceases to be very effective when applied to cheap wood lands.

The problem of caring for residential conditions has been solved, and it is no more a perplexing question, for only in those cities and towns that are naturally nonprogressive in all their business relations is there likely to be any trouble. The purely country problem, however, is perplexing, and demands much more consideration. It has been the aim of the State Forester, therefore, to make the older sections, that have received assistance from the State for some time, assume the responsibility of self-support as rapidly as possible, so that the State's appropriation may be used where it is more needed, in the rural sections. In last year's report a brief account was published, so that no town could have an excuse for not knowing its conditions.

We have finally prevailed upon the federal government to assume the parasitic work, to which Massachusetts has contributed $15,000 a year until this season, and at present the government is preparing to establish a belt or picket line (see accompanying map) along our outer border of infestation, with the purpose of preventing the insects from spreading further. Hereafter everything beyond this border will be government work. This plan was advocated by the State Forester three years ago, and it is believed that now, with a more definite policy, the outlook is very bright for future work. This arrangement gives Massachusetts a definite work to perform, namely, to improve her internal conditions.

The infestation of the gypsy moth is not as great as we approach the government picket line, as some of the towns just within this line have but few of the insects. It is nevertheless important that these towns receive early attention from an economic standpoint. It seems to be natural that newly infested towns are relatively indifferent at first, and also, the employees are untrained and unskilled. This, together with the fact that most


MASSACHUSETTS
INFESTATIONS
OF THE GYPSY
AND BROWN-TAIL
MOTH
EXPLANATION
TOWNS INFESTED BY BOTH GYPSY AND BROWN-TAIL MOTHS
GYPSY MOTHS ONLY
BROWN-TAIL MOTHS ONLY
DIVISIONS
U.S. GOVERNMENT GYPSY MOTH WORK IS CARRIED ON WEST OF LINE S-S
TOWNS THAT HAVE LARGE POWER SPRAYERS
TOWNS THAT HAVE SMALL POWER SPRAYERS
STATE FORESTERS
OFFICE 1913
F. L. HAYNES

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towns insist on employing home labor, accounts for the unsatisfactory conditions that follow the early work. This criticism is simply to point out what this department has to contend with. I realize that it is perfectly natural that town officials feel it is encumbent upon them to give employment to their own townsmen in preference to others, but in this case it would be better to import an experienced foreman, at least until such time as local men have become sufficiently trained.

The State Forester believes that in dealing with this moth problem it will be good business to keep up the work of the present with the idea of gradually placing the burden upon towns and cities.

In my last year's report a definite recommendation was outlined whereby the State appropriation should be lessened $65,000 last year and $50,000 each year thereafter for three years. I am still of the opinion that we should carry out that policy. Such a gradual curtailment on the part of the State would not interfere with the efficiency of the work.

In dealing with the moth problem I am frank to say that every endeavor is being made to impress our employees with the idea, already alluded to in another place in this report, that better forestry is the solution. This means that we are to change our point of view from a policy that is unpopular and expensive, although necessary, to a constructive one, namely, the conservation of our forests. What a showing could be made were we able to utilize the present expenditure in moth work for pure forestry! It is firmly believed that with a consistent policy we may attain that much-coveted goal.

The practice of furnishing with supplies in place of money the towns and cities that the State reimburses has been carried out for the past three years, with great economy to the State.

During the past season some readjustments have been made in the moth divisions. Three of the division superintendents were supplied with runabout automobiles in place of motor cycles, and this made possible their covering larger territories. The price of runabouts has now reached a point where they can be used economically.

Private Property Work.

One of the most encouraging features of the year is the interest on the part of local superintendents in accomplishing as much work as possible that is self-supporting. A few years ago it was very easy for the public and private work to be so mixed that the cities and towns came to the State for a larger reimbursement than they should. Now we have a comprehensive knowledge of the area and the number of trees to be cared for in the cities and towns, and hence can estimate the approximate expense necessary to treat them. Once the strictly public work is planned for, the remainder of the trees in the city or town are cared for by the local superintendent at cost to the owner. This method has had a tendency to make individuals depend upon the town force to do their work, or have it done for them. The more private work that a superintendent can get done, the less the amount of future public work, since the one spreads to the other. The amount of private work accomplished in many places the past season is certainly creditable to the local officials in charge. In order to accomplish this work, as alluded to elsewhere in this report, equipment and trained, reliable employees are essential.

Work on State Highways.

During the past year the moth work on the State highways has been done under the supervision of this department, and the expenses paid by the highway commission. Besides the gypsy and brown-tail moth work we also attended to the elm-leaf beetle spraying and did some improvement pruning. This work is usually done by our various local superintendents, under the supervision of this office. It is believed that the highway commission should be given a much larger appropriation for this and similar work. Next to good roads themselves, well-planted and properly cared for shade trees are appreciated by everybody; in fact, they make a country desirable to live in. In this connection I would suggest the advisability of making the town tree warden an appointive rather than an elective office, similar to the forest warden appointment, so that if a definite policy for setting out and caring for shade trees were outlined results would follow. At present, one town does well, while its neighbor may be indif-

ferent. The tree warden, since the position is an elective one, is also changed too often, and is usually given little financial backing.

Work has been done in the following cities and towns on the State highway, and paid for by the highway commission: —

Acton,	$186 17	Methuen,	$95 30
Amesbury,	56 28	Middleborough,	95 52
Andover,	85 63	Millbury,	47 50
Ashby,	21 75	Milton,	7 92
Ashland,	84 00	Newbury,	73 40
Attleborough,	34 90	Newburyport,	40 05
Barnstable,	150 00	North Andover,	150 60
Barre,	17 83	North Attleborough,	70 45
Bedford,	59 75	North Reading,	21 00
Beverly,	374 67	Northborough,	119 10
Billerica,	63 75	Norton,	45 70
Boxborough,	194 10	Norwood,	17 75
Brewster,	82 95	Orleans,	25 00
Bridgewater,	119 04	Pepperell,	81 41
Brockton,	63 13	Plainville,	23 90
Burlington,	61 00	Raynham,	13 00
Chatham,	25 00	Reading,	153 00
Chelmsford,	85 80	Rehoboth,	149 50
Concord,	507 94	Rockland,	82 35
Dennis,	57 40	Rowley,	85 71
Dighton,	114 35	Salisbury,	75 69
Dracut,	68 10	Scituate,	102 50
Duxbury,	13 80	Somerset,	198 75
Falmouth,	91 56	Sterling,	63 86
Fitchburg,	62 73	Stoneham,	100 80
Foxborough,	75 00	Sudbury,	139 90
Framingham,	55 62	Sutton,	10 75
Gloucester,	14 70	Swansea,	115 38
Grafton,	47 50	Taunton,	47 25
Groton,	120 85	Templeton,	67 25
Groveland,	71 10	Tewksbury,	99 27
Harvard,	63 98	Townsend,	274 50
Harwich,	25 00	Tyngsborough,	147 00
Haverhill,	149 74	Wayland,	61 75
Hingham,	21 63	Wenham,	136 96
Holliston,	180 62	West Bridgewater,	19 15
Hudson,	31 50	West Newbury,	154 90
Ipswich,	43 48	Westford,	123 00
Lakeville,	30 67	Weston,	113 30
Lancaster,	55 58	Wilmington,	22 80
Leominster,	35 25	Winchester,	265 91
Littleton,	61 95	Woburn,	92 20
Lowell,	28 34	Worcester,	18 92
Lunenburg,	60 19	Wrentham,	40 00
Mansfield,	19 64	Yarmouth,	150 00
Marion,	8 00		
Melrose,	78 60		$8,064 22
Merrimac,	63 70		

In the following towns work was done on the State highways under the direction of the State Forester's office, and paid for by the State Forester from the appropriation for the suppression of the gypsy and brown-tail moths: —

Abington,	$19 25
Bedford,	27 17
Bellingham,	12 90
Braintree,	38 00
Cohasset,	32 72
Dover,	24 50
Duxbury,	8 04
Hamilton,	113 32
Hanover,	24 18
Hingham,	85 00
Kingston,	9 28
Lincoln,	87 59
Marlborough,	197 36
Marshfield,	20 97
Melrose,	46 24
Millbury,	4 47
Natick,	58 89
Newbury,	$55 08
Norfolk,	10 50
North Attleborough,	3 00
Pembroke,	6 50
Quincy,	12 00
Randolph,	17 80
Scituate,	88 74
Shrewsbury,	272 50
Southborough,	30 62
Stoneham,	62 78
Stoughton,	41 00
Weymouth,	138 61
Wilmington,	48 44
Winchester,	49 56
Woburn,	213 86
	$1,860 87

Parasite Work.

Report of Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, D. C.

United States Department of Agriculture,
Bureau of Entomology, Washington, D. C., Dec. 7, 1912.

Prof. F. W. Rane, *State Forester, 6 Beacon Street, Boston, Mass.*

Dear Professor Rane: — In accordance with your request, I take pleasure in enclosing a report on the parasite work of this year, for inclusion in your annual report.

Yours most truly,
L. O. Howard,
Chief of Bureau.

Down nearly to the date when I submitted my last report to you, namely, Dec. 15, 1911, all of the work on the parasites of the gypsy moth and brown-tail moth had been carried on co-operatively between the State of Massachusetts and the Bureau of Entomology of the United States Department of Agriculture, and on the whole the expense of the work was about equally shared. The co-operation on this project between the State and the Department of Agriculture was in effect for about six years, and was thoroughly satisfactory. Without the assistance of the State the operations by the department could not have been carried on upon so large a scale as has been possible. The most cordial relations have

existed and the most perfect facilities have been offered to experts of the Bureau at the expense of the State. The growing importance of the work, and the urgent need for the diversion of all possible State funds to other aspects of the investigation, brought about a transfer, which was entered into Dec. 1, 1911, all of the parasite work being taken on by the Bureau. A number of State employees were transferred to the Bureau rolls, so that their previous training and experience were available.

In my report to you submitted December 15, I summarized most of the results of the year 1911, including many facts in addition to those contained in my annual report as Chief of the Bureau of Entomology, which considered matters only down to the 1st of July. Most of the material received during the latter part of the season of 1911 was wintered at the laboratory at Melrose Highlands, and during the spring of 1912 there was a good emergence of parasites, and several vigorous colonies were liberated. The parasite found by Mr. Fiske in Sicily in 1911, and of which 125,000 cocoons were sent over, survived the winter successfully in Massachusetts, and during May and the first half of June, 1912, about 12,000 adults were put out in the field. A species of *Apanteles*, which was received in small numbers, passed through the winter in good condition, and a small colony was placed out. Females of this species lay their eggs in small caterpillars, and the insect has now passed through a generation since it arrived in this country.

The egg-parasite known as *Anastatus bifasciatus*, a species having only one annual generation, and coming from both Japan and south Europe, has been breeding in practically all of the places where it has been colonized. It spreads very slowly, however, and it is necessary to make many plantings in order that it may become generally distributed. In some of the collections of egg masses, as high as 47 per cent. of the eggs were found to be parasitized. More than 700 additional colonies of this species were put out during the spring of 1912.

The Japanese egg parasite, *Schedius kuvanæ*, has been increasing rapidly, has several generations each year, and the outlook for its perfect establishment is very favorable.

Never, however, under any circumstances, may we expect that these two egg parasites together will destroy more than 40 per cent. of the eggs, since they are confined in their operations to the upper layer of eggs in any given egg mass. A reduction of 40 per cent. in the eggs, however, will be a great gain.

The European Calosoma beetle has become thoroughly established, and has caused much destruction among gypsy moth caterpillars and pupæ. It has been found in numbers as far north as Portsmouth, N. H., and in practically all of the towns in New Hampshire south of a line drawn from Portsmouth to Lowell, Mass. Last year this species was found in only a single town in New Hampshire. In the central infested district in Massachusetts adults and larvæ of this species, both of which feed upon gypsy moth caterpillars and pupæ, were so common that they were ob-

served by many citizens, and many specimens have been found on the sidewalks in the suburbs of Boston, where they had been stepped upon by pedestrians.

The European Tachinid fly, *Compsilura concinnata*, was also very abundant this year, and did excellent work in the vicinity of Boston. From a collection of about 12,000 caterpillars made in Stoneham, Saugus and Melrose, Mass., it was found that over 25 per cent. were parasitized by this insect.

An unlooked-for development occurred during the summer when small gypsy moth caterpillars were found to have been parasitized by *Apanteles lacteicolor*, another introduced parasite. Previously, only a single cocoon had been collected, in the summer of 1911. During the summer of 1912 the parasitism of gypsy moth caterpillars by this insect has been found over a wide area, from as far north as Manchester, N. H., to Hudson, Marlborough, and towns in this vicinity in Massachusetts, and also in towns around Boston. On account of the difficulty of observing this species, it is probably safe to say that a large amount of beneficial work performed by it has escaped notice.

Some of the other parasites, such as the Tachinid, Blepharipa, are increasing, as has been demonstrated by the work done during the past year.

In several places in the area which was badly infested during past years, it is a fair estimate that 50 per cent. or more of the gypsy moth larvæ, pupæ and eggs were destroyed during the summer of 1911 by the parasites above mentioned. In other areas, farther from the centers of parasite plantings, of course, so good a showing was not made.

It should be stated that the wilt disease was present during the season of 1912 as heretofore. It was almost impossible to find an infested area where the disease was not present some time during the caterpillar season.

The present condition of the brown-tail moth indicates a greater measure of control by introduced parasites than ever before. During the spring of 1912 climatic conditions were such that the fungous disease which attacks this insect in early June did not develop to any marked extent in the region about Boston. The previous winter was very severe, and many collections of brown-tail nests were made to determine the number of caterpillars which died in the webs during the winter from cold weather or other causes. The records from Maine, New Hampshire and the western part of the infested area in Massachusetts showed that a far larger percentage of dead caterpillars were found in the webs than in the districts surrounding Boston. This being the case, one would naturally expect a large increase in the brown-tail moth infestation about Boston this autumn. The condition of infestation, however, is not nearly so great as would be expected, and, as the fungous disease worked to a very slight extent in this particular region, it is reasonably obvious that the parasites were largely responsible for the present decrease. Collections and recoveries from the field also showed that the species which were most abundant in this region last year were far more common in 1912. *Apanteles lacteicolor*,

Meteorus versicolor and *Compsilura* were very common and doing effective work.

The parasites of the brown-tail moth, referred to in last year's report, have increased in spread over a much larger territory than last year. The trend of the dispersion has been in a north and northeast direction, and has followed the same general lines as the brown-tail spread. The Chalcidid parasite, *Monodontomerus æreus*, has been found beyond the city of Bangor, Me., and as far north as the brown-tail moth has spread in New Hampshire. In Massachusetts and Rhode Island the spread of this species very nearly covers the range of the brown-tail moth. The first of the brown-tail moth winter nests parasites to be found established in this country, and to which I have made frequent references in my reports to you, namely, *Pteromalus egregius*, has also showed a good increase and spread over the previous year.

In furtherance of the proposed study of European conditions, especially regarding parasitic control in Europe, Mr. W. F. Fiske, with two expert assistants, was located in south Europe during the winter, spring and early summer.

It is especially encouraging to note that over a considerable territory centering a little to the northward of Boston, in which a greater variety of parasites are established in greater abundance than elsewhere, the effects of their importation are already noteworthy. It is safe to say that, on the most conservative estimate, 50 per cent., or one out of every two eggs, caterpillars or pupæ of the gypsy moth, was destroyed by imported parasites in 1912.

Present Status of the Wilt Disease or "Flacherie."

When one reflects upon the tremendous capacity of the gypsy moth for causing damage to woodlands and shade trees, and fully realizes the vast amount of money which has been expended by Massachusetts in her efforts to suppress it; and moreover, as it is obvious that the spread of the moths over thousands of square miles, in many sections of which it is still abundant, justifies the belief that we shall be compelled to continue the fight against it indefinitely, unless more effective methods than those now employed are discovered, the State Forester's position easily may be understood in attempting to utilize anything which offers reasonable hope of effectiveness. In former reports reference has been made to the experimental work with the "flacherie" or wilt disease, which has been carried on under the direction of Dr. W. M. Wheeler of the Bussey Institution of Harvard University. The experiments were continued during 1912, and owing to improved facilities for developing it a greater number of plantings of the

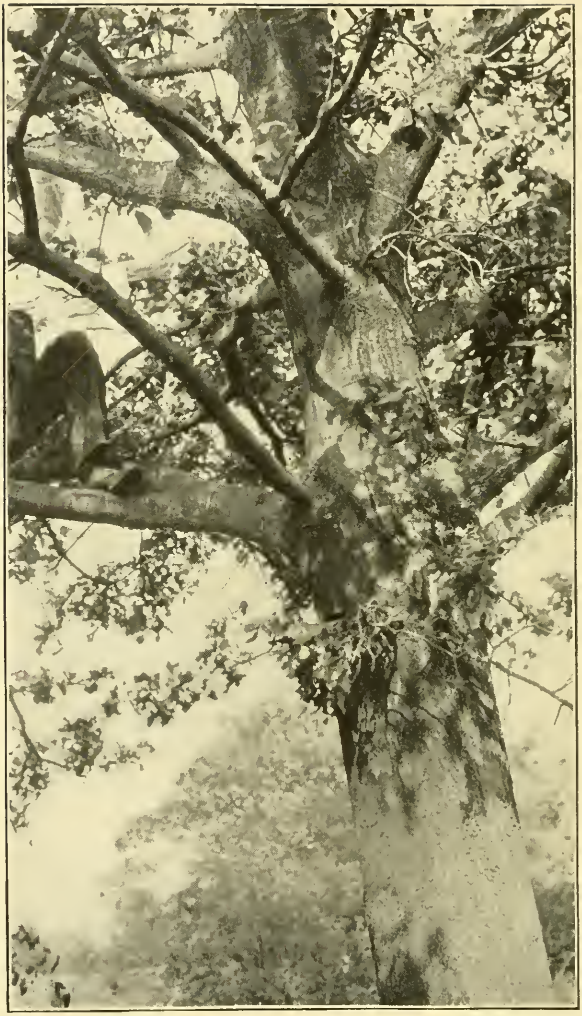
material were made than in any previous year. In fact, the disease has now been distributed over the entire moth-infested area of the State. In view of the fact that the results of this planting are still problematic, it does not seem advisable to persevere in this work. Further investigations show that our knowledge of the disease is still fragmentary, and we must wait further development before expending more money. The experimental and scientific side of the work is now being prosecuted systematically by the United States Bureau of Entomology and by Harvard University in co-operation. We append a letter recently received from Professor Wheeler of the Bussey Institution of Harvard University which explains more fully the feeling among scientists in regard to the probability of success in attempting to spread wilt disease of the gypsy moth artificially. Professor Wheeler is not alone in his opinion, for it is shared by the most celebrated scientists abroad and by many prominent entomologists here in Massachusetts.

"Flacherie" Opinion of Professor Wheeler.

Bussey Institution, Forest Hills, Mass., Nov. 20, 1912.

Mr. F. W. Rane, *6 Beacon Street, Boston, Mass.*

My dear Mr. Rane: — In obedience to your request I beg leave to submit to you my opinion in regard to continuing the practice of attempting to spread the wilt disease, or "flacherie," of the gypsy moth caterpillars by artificial means in the forest lands of eastern Massachusetts. It is obvious that any attempt thus to utilize the wilt disease in practice must be based on a precise knowledge of the methods whereby the disease may be contracted by healthy caterpillars. Although we have good evidence for believing that the disease may be contracted by healthy caterpillars that have fed on the excretions of diseased caterpillars, or the deliquesced portions of caterpillars that have died of the disease, we have at present no data to prove that the disease can be transmitted from diseased to healthy caterpillars by mere bodily contact or by germs borne through the air. Many experiments have been performed for the purpose of proving the method of transmission last mentioned, but these, in my opinion, have given merely negative or highly equivocal results, owing to the fact that the disease, in a mild or latent form, is chronically, and perhaps hereditarily, present in practically all the localities in which the caterpillars occur in eastern New England. The acute and economically important phase of the disease may, therefore, arise through unusual meteorological conditions, or through peculiarities of the plants on which the caterpillars happen to be feeding. Hence, there is no advantage in



A photograph showing millions of dead brown-tail larvæ on the under part of the limbs, as the result of a single planting of the fungous disease.

continuing such experiments till the precise methods of infection and of its specific organism have been determined by carefully controlled laboratory experiment and protistological investigation. Such investigations are being pursued, with improved facilities, by the federal Entomological Bureau in co-operation with the Bussey Institution of Harvard University, and may be expected to yield, in the not too distant future, some adequate theoretical basis for a sound practical utilization of the disease in the field.

Very sincerely yours,

W. M. Wheeler,
Professor of Economic Entomology.

The Fungous Disease of the Brown-tail and Gypsy Moths.

The same co-operative arrangements, as heretofore, were made with Harvard University, through Dean W. C. Sabine and Dr. Roland Thaxter, for carrying on this work. Mr. R. H. Colley was in charge assisted by some of our regular employees when occasion demanded it. The work was carried on at the Harvard Botanic Gardens, and we are greatly indebted to Harvard University for the use of their greenhouse and cold frames as well. The following report by Mr. Colley explains itself: —

Planting was commenced on the 6th of May, a week later than in previous seasons, on account of the late start of the larvæ in the field and general cold weather conditions, and continued until the 6th of June. Mailing cases again were used for the distribution of the diseased caterpillars. In sending out the material it was planned to supply the different districts with infected larvæ on definite dates, to ensure, as far as possible, that the planting would be done immediately on receipt of the material. This scheme was adhered to, with few exceptions. Approximately 200 cases were shipped to State and town superintendents all over eastern Massachusetts. The division superintendents supervised the work in order to acquaint the town men with the proper methods of handling and planting the material. Besides this distribution about 100 cases were shipped to private individuals during the first week in June.

The results of nearly all of the plantings were very satisfactory. Inspection of the planted areas by local and division superintendents showed that the disease had materially decreased the number of larvæ, and in some cases had killed practically all of them. Some failures were reported, which were undoubtedly due to delay in transit or material sent out when the infection in the disease boxes was low. Viewing the work as a whole, the season may be said to have been very successful. The results certainly seemed to indicate that a more extensive planting of the fungus would be even more effective in reducing the numbers of the caterpillars.

To carry on the work properly a breeding and infection house is needed in which light and heat can be well regulated. A good supply of clean dry nests for cold storage is also absolutely necessary. This supply should be large enough to furnish caterpillars for running at least twenty-four disease boxes, a number which ought to yield enough diseased larvæ to supply every infested town in the State. To feed such a large number of caterpillars some arrangements should be made for procuring a sufficient quantity of willow and cherry twigs, or for the cultivation of raspberry bushes, which yield tender leaves especially suited to the needs of the very young larvæ. Success depends on a large quantity of well-infected material which can be rapidly transported to the field. If this material is quickly and properly planted, there can be no question as to its effectiveness in destroying the brown-tail caterpillar.

It was impossible to run the brown-tail fungus through the summer in the disease boxes, on account of the lack of a proper supply of larvæ in cold-storage, but the infection was successfully started from diseased webs during the first week in September.

In the case of the experiments with the gypsy fungus the results were not satisfactory. The larvæ did not thrive well in the breeding boxes, because the conditions in the boxes, where warmth and moisture were at an optimum for *Entomophthora*, were extremely favorable for the development of wilt, and the caterpillars died from this disease before the fungus could spread. Another factor which makes the propagation of the disease difficult is the apparent low virulence of the species which attacks the gypsy moth. Only one planting was made, at Stony Brook, about the 25th of June. Inspection ten days later resulted in the finding of one dead caterpillar, on a small branch about five feet above the bag in which the diseased larvæ had been planted. No other evidence of the fungus could be found. That the gypsy fungus will prove as destructive as the brown-tail fungus seems, in view of the negative results so far obtained, to be very doubtful, but there is a possibility that it may get started from some of its numerous resting spores which must be in the field in localities where the fungus was planted, in which case its effectiveness might prove to be greater than our experiments would indicate.

Quarantine against the Gypsy Moth and the Brown-tail Moth.

As a result of a hearing held at Washington, D. C., on Oct. 29, 1912, before the Federal Horticultural Board, the Department of Agriculture has established a quarantine against the above-named moths which took effect on and after Nov. 25, 1912. The regulations are as follows: —

Gypsy Moth Regulations.[1]

Coniferous trees of the area quarantined for the gypsy moth, such as spruce, fir, hemlock, pine, juniper (cedar), and arbor-vitæ (white cedar), known and described as "Christmas trees," and parts thereof, and decorative plants of the area quarantined for the gypsy moth, such as holly and laurel, known and described as "Christmas greens or greenery," shall not be moved or allowed to move interstate to points outside the quarantined area.

Forest plant products of the area quarantined for the gypsy moth, including logs, tan bark, posts, poles, railroad ties, cordwood and lumber, and field-grown florists' stock, trees, shrubs, vines, cuttings, and other plants and plant products for planting or propagation, of the area quarantined for the gypsy moth, excepting buds, fruit pits, seeds of fruit and ornamental trees and shrubs, field vegetable and flower seeds, bedding plants and other herbaceous plants and roots shall not be moved or allowed to move interstate to any point outside the quarantined area unless and until such plants and plant products have been inspected by the United States Department of Agriculture and pronounced free from the gypsy moth.

Brown-tail Moth Regulations.[1]

Deciduous trees or shrubs of the area quarantined for the brown-tail moth, or parts thereof, including all deciduous field-grown florists' stock, vines, cuttings, grafts and scions, shall not be moved or allowed to move interstate to points outside the quarantined area, unless and until such plants and plant products have been inspected by the United States Department of Agriculture and pronounced to be free from the brown-tail moth.

North Shore Work.

The co-operative work along forestry and moth lines that has continued now for several years between the summer residents committees, the towns and the State Forester's department, has again been continued throughout the past season. The State Forester wishes to acknowledge the very public-spirited interest that has been shown generally in this work, and especially is he indebted to Col. Wm. D. Sohier for his unfailing support, which has made the work possible.

The following is a reproduction of that portion of the summer residents committees' report that relates to the moth and forestry work: —

[1] Blanks on which to make application for inspection or for permits to ship will be furnished upon request by the United States Department of Agriculture, 6 Beacon Street, Boston, Mass.

Gypsy Moth and Road Work on the North Shore

General Purposes.

This is the fifth season that your committees have been engaged in preserving the forests on the North Shore. Each year the work has been more and more consolidated for the purpose of preserving the woods directly back of the valuable shore property, and also for the purpose of preserving a strip 200 feet wide on the sides of our beautiful wooded drives.

The conditions in the woods as a whole on the North Shore are much better in 1912 than they have been at any time in the past.

The fact has been demonstrated beyond question that by thorough, systematic work the forests can be preserved, and we think improved as well. Half measures are merely a waste of money. The taking out of the poorer trees and of the dead wood will undoubtedly in a short time result in much better forests.

Scope of the Work.

Your committees have continued their policy of co-operating with subscribers who are doing thorough work, by endeavoring to give them a protective belt back of their estates.

We have now cleared up, creosoted and sprayed a strip 200 feet in width on the sides of all of the wood roads, — something over 30 miles, — besides caring for the woods on the sides of the main roads. The work has been done all the way from Beverly Hospital in Beverly, nearly down to the line of Gloucester harbor.

In the interior of the woods very little, if any, work has been done. While in many places there is a large number of dead trees, they are mostly the weaker trees, which could not stand one stripping, but it has seemed to the inspectors, and to the writer, after considerable exploring, that even in these woods the conditions are much better than they have been before.

The summer residents in Magnolia contributed nearly $3,000, and we secured an equal amount from the State, but this year the city of Gloucester refused to contribute the $2,500 which it had been contributing for the past two years.

The work of cleaning up the whole block on the east side of Greenwood Avenue is nearly completed, so that Pride's Hill, with its beautiful woods, will be preserved. They were in very bad condition.

Parasites.

More parasites were planted again this year, and I think the conditions in the back woods indicate clearly that the parasites have been increasing. We also put out a large number of diseased caterpillars and flacherie, or the so-called "wilt disease." This latter was effective in many places.

While it will be several years before the parasites, that attack the moth in all the stages of its growth, will be thoroughly developed, they will certainly render substantial aid in the back woods.

One of the cheapest and most effective methods of preserving the woods, and reducing the cost of the work, is to cut out all the trees, like the white oak, etc., which are particularly infested by the gypsy moth, and leave only the more resistant trees, such as pines, hemlocks, beeches, etc. We are doing this wherever we can, and the results are excellent. If one can cut all the white oaks, even, it will add greatly in reducing infestation, and make the work much easier and less expensive.

Future Work.

It seems as if in the future we could, to a certain extent, curtail the amount of work that is to be done where the woods are not of any great public value, and we are doing the work merely to preserve the forests which can be seen and the private estates. In some colonies it will be possible to get along with merely creosoting for one year, and still keep the gypsy moth under control; in other colonies we can spray and do no other work. It is possible, in a few of the back colonies, that we can work only alternate years, and still prevent the gypsy moth from increasing.

Work done.

We exceeded all former records this year, partly because we were favored with good weather, but principally because of the increased efficiency of our men and our spraying machines.

There were 3,774 acres sprayed in twenty-three days. We had 13 power spraying machines actively at work, and 1 motor truck spraying machine. This truck took care of all the roadsides very much more advantageously, and for very much less money, than they had ever been cared for before.

We had only two serious breakdowns, but in each case the spraying machine was repaired over night and was working the next day. We are now organized so as to do our own work and repair our own machines.

To a large extent this increased efficiency was secured by employing a high-priced and competent mechanic, and by keeping the parts and supplies constantly on hand.

Your committees have adopted the policy of keeping enough of its more experienced men employed during the winter so that it will have efficient and competent foremen to direct the work the next year. This has proved a great economy.

When the work started, with the low-power spraying machines we could not throw to the tops of the trees. It was then considered a good day's work when a gang of 11 men and 1 power sprayer sprayed 5 or 6 acres a day. This year it was no unusual occurrence, where conditions were favorable, for one of the new machines, with the same number of men, to spray 18 acres a day.

The average acreage sprayed by each machine this year was something over 12 acres per day for the whole twenty-three days. We sprayed on an average 164 acres a day.

Plant.

Your committees have now 1 automobile truck equipped for spraying, 12 modern power-spraying machines, 3 auxiliary pumps, 1,000 feet of hose with each spraying machine and with each pump, and 2 watering carts.

This year we bought 1 new sprayer and rebuilt 3 of the old ones, making them as good as new. We have still two or three machines which are two and three years old, which will probably be sold.

Persons in Charge of the Actual Work.

The actual work was in charge of the State Forester's department, under Mr. F. W. Rane. Mr. George A. Smith, gypsy moth superintendent, supervised the work, and was extremely efficient and interested. Locally, the work was in charge of Mr. Saul Phillips, who has been in charge practically ever since the work started, five years ago. He had with him his assistant, Mr. M. H. Donovan.

Your committees arranged that, in order to secure efficient inspection and rapid repairs, Mr. Phillips should have an automobile and Mr. Donovan a motorcycle. Your committees feel that we owe a great deal to these gentlemen and their able foremen for their tireless labors, especially during the spring season.

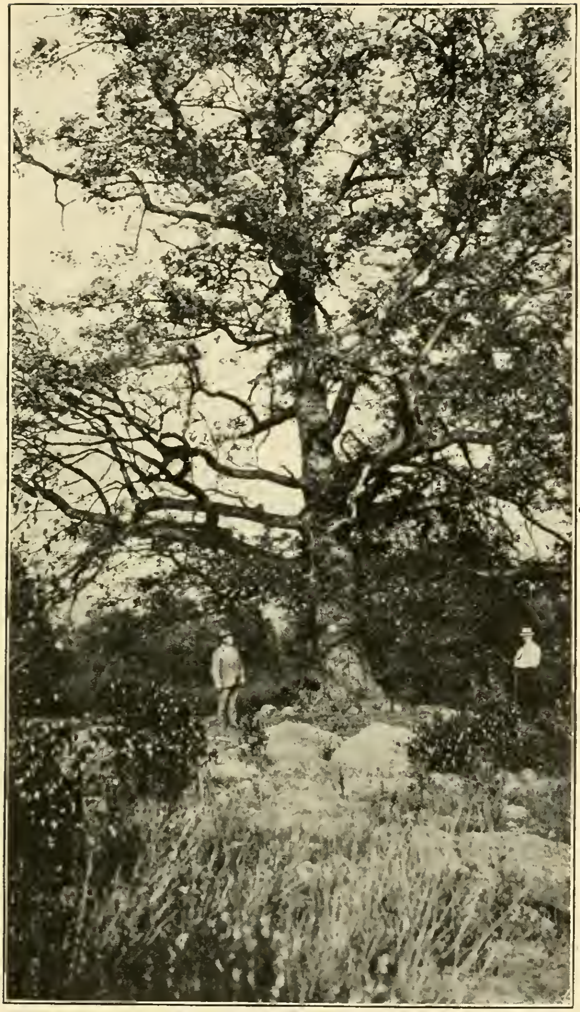
Under the State law it is doubtful whether it was legal for the men to be employed more than eight hours a day. The men desired to work more, and would have left us if they had not been allowed to work more hours, because they wished to secure the additional pay. Consequently, your committees arranged so that the men worked for the State eight hours a day, and your committees employed them and paid them at the same rate for the additional hours they put into the work, thereby securing the best results.

It seemed to your committees that the authorities should have ruled that this was emergency work, as it was evident that curtailing the hours would mean that 30 less acres would be sprayed each day and that the moths would be allowed to destroy the woods on that much territory, or at any rate seriously injure them, and of course it is clearly evident that 30 acres a day less for the twenty-three days would mean that the moths would have been allowed for that thirty days to defoliate some 690 acres of woods.

We hope that some legislation will be passed this year which will help the matter and exempt spraying, at least, from the eight-hour law.

How the Money was Secured.

Governor Foss early in the year agreed that the State would co-operate in 1912 as it had been doing ever since 1908. The State Forester's department took charge of the whole work. The following appropriations were secured: —



A mammoth pasture oak that was badly infested with gypsy moth egg clusters. This photograph was taken at the end of the feeding season, showing how the foliage has been maintained; the only treatment was the banding of the trunk with tanglefoot.

Commonwealth of Massachusetts,	$22,500 00
City of Beverly,	5,000 00
Town of Manchester,	5,000 00
Contributed by your committees,	23,000 00
Collected from private owners for work done on the woodland,	4,360 77
	$59,860 77

This money was all paid into the State treasury for moth work on the north shore, to be used by the State Forester's department.

His Excellency Governor Foss has at all times been interested and ready to co-operate with the efforts of your committees. Had it not been for this co-operation our forests would undoubtedly have been destroyed.

Expenditures.

According to the report of the State superintendent, the expenditures were as follows: —

From July 16, 1911, to July 30, 1912,	$55,453 94
Tools and supplies bought for 1911 work,	18,520 89
Balance,	$36,933 05
Due for tools and supplies, 1912 work,	13,516 75
	$50,449 80
Less value of tools and supplies on hand,	13,421 84
Actual cost of the work done by State,	$37,027 96
Overtime paid by committees,	974 02
Total cost of work, not including plant,	$38,001 98

Details of Cost of the Work.

Spraying,	$17,328 56
Cutting and burning,	13,251 67
Creosoting,	6,316 13
Tanglefooting,	744 60
Leopard moth work,	238 29
Road repairs,	73 10
Replanting wilt disease,	49 63
	$38,001 98

The Work accomplished.

Roughly speaking, about 1,000 acres of woodland were cleared and sprayed in 1908, about 2,100 acres in 1909, about 3,000 acres in 1910, about 3,200 acres in 1911, and over 3,600 acres in 1912.

The cost of the work was approximately as follows: —

1,000 acres in 1908,	$60,000
2,100 acres in 1909,	60,000
3,000 acres in 1910,	57,000
3,200 acres in 1911,	54,500
3,600 acres in 1912,	38,000

The acreage cared for in 1912 was three and one-half times that cared for in 1908, and the expenditure only three-fourths as much.

We also did some fall spraying in the fall of 1911 for brown-tails on 162 acres. Our force varied from 25 men to over 150.

Average Cost of the Work.

Spraying 3,774 acres,	$4 59 per acre.
Creosoting 2,744 acres,	2 30 per acre.
Cutting 1,368 acres,	9 68 per acre.

These costs do not include tools, plant, etc., nor depreciation, merely labor and materials.

Where work was done on private estates, which was only in the back woods where it came in connection with other work your committees were doing, the cost of the work is being repaid by the owners whenever they can afford to pay for it.

Co-operation by the Commonwealth and the Cities and Towns.

Your committees feel that the summer residents owe a great deal to Governor Foss and his State officials, the State Forester, superintendent and men in charge of the work, to the mayor and city government of Beverly, and to the selectmen of Manchester, for their generous help and co-operation, without which it would have been impossible for your committees to have done systematic, thorough and efficient work against the gypsy moth under one responsible head, and without regard to town lines. The selectmen of Hamilton have also co-operated by caring for many of the woods in that town. Without this co-operation and the money given by the State, municipalities and subscribers, our forests and beautiful shore would have been greatly injured.

It requires a large amount of pluck, as well as sound business judgment on the part of city and town officials in these days, to authorize the spending of money in their charge by an outside committee or commissioner, or by others than town and city officials. We believe, however, that the results obtained are ample justification of their action.

Our Hopes for the Future.

Our forest can be preserved, our wood roads protected and the shore remain as beautiful as it is now, provided the work is continued on the lines on which it has been begun.

It is the opinion of the best experts that in the back woods the various parasites will soon maintain a kind of equilibrium which will prevent the trees which are yet particularly susceptible to the attack of the gypsy moth from being destroyed.

Your committees hope that the subscribers, the Commonwealth and the cities and towns will co-operate in the future as they have in the past. They hope that every resident and summer resident on the North Shore

who has enjoyed our woods, our trees and our dustless roads, and who has not yet subscribed, or who has not yet given his fair share towards the cost of this work, will co-operate by sending a check to Wm. D. Sohier, agent, 15 Ashburton Place, Boston, Mass.

A list of the subscribers is published herewith.

WM. D. SOHIER,
For the Committees.

Beverly.	*Manchester.*
OLIVER AMES.	MAJ. HENRY L. HIGGINSON.
CHARLES H. TYLER.	GARDINER M. LANE.
WM. D. SOHIER.	GEORGE WIGGLESWORTH.

Summer Residents Committees.

SUBSCRIPTIONS FOR GYPSY MOTH WORK ON THE NORTH SHORE, 1912.

Beverly.

Henry C. Frick,	$2,000 00
Hon. Wm. H. Moore,	1,000 00
W. S. and J. T. Spaulding,	500 00
Mrs. Chas. H. Dalton,	400 00
Mrs. R. D. Evans,	300 00
Dudley L. Pickman,	300 00
Hon. Wm. C. Loring,	250 00
Charles H. Tyler,	250 00
John L. Saltonstall,	250 00
Robert S. Bradley,	250 00
Francis Bartlett,	250 00
William Endicott,	250 00
Alexander Cochrane,	250 00
Amory A. Lawrence,	250 00
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Oliver Ames,	250 00
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Wm. D. Sohier,	250 00
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Cranmore N. Wallace,	200 00
W. B. Thomas,	200 00
Neal Rantoul,	200 00
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Henry P. King,	200 00
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Mrs. John S. Curtis,	150 00
Philip S. Sears	150 00
F. J. and Alice Cotting,	125 00
George S. Mandell,	100 00
F. I. Amory,	100 00
Allen Curtis,	100 00
Franklin Dexter,	100 00
Harold J. Coolidge,	100 00
Mrs. John A. Burnham,	100 00
Mrs. E. P. Motley,	100 00
The Misses Paine,	100 00
A. Shuman,	100 00
Augustus P. Loring,	100 00
Miss Frances R. Morse,	100 00
The Misses Loring,	100 00
Mrs. G. H. Shaw,	100 00
George A. Goddard,	100 00
Bryce J. Allan,	100 00
Col. C. L. Peirson,	100 00
Messrs. A. B. and T. Silsbee,	100 00
Mrs. James F. Curtis,	100 00
Frederick R. Sears,	100 00
Miss Katherine Silsbee,	100 00
Hon. Geo. H. Lyman,	100 00
Mrs. John C. Phillips,	100 00
Mrs. Guy Norman,	100 00
Horace D. Chapin,	50 00
C. K. Cummings,	50 00
O. W. Holmes,	50 00
James L. Paine,	50 00
Gordon Dexter,	50 00
Mrs. F. H. Peabody,	50 00
T. C. Hollander,	50 00
A. C. Ratshesky,	25 00
	$15,150 00

Manchester.

Charles E. Cotting,	$500 00	T. Dennie Boardman,	$100 00
George R. White,	500 00	Thomas B. Gannett,	100 00
George N. Black,	500 00	Richard H. Dana,	100 00
Mrs. R. C. Winthrop,	250 00	Executors of Myron C. Wick,	100 00
Mrs. Chas. S. Hanks,	250 00	T. Jefferson Coolidge,	100 00
George Wigglesworth,	250 00	William Hooper,	100 00
Gordon Abbott,	250 00	Amory Eliot,	100 00
Edward S. Grew,	250 00	J. L. Thorndike,	100 00
Henry L. Higginson,	250 00	S. Parker Bremer,	100 00
Gardiner M. Lane,	250 00	Richard Stone,	50 00
Wm. B. Walker,	250 00	Mrs. Geo. D. Howe,	50 00
Mrs. Henry S. Grew,	250 00	The Misses Bartlett,	50 00
Mrs. James McMillan,	250 00	Roland C. Lincoln,	50 00
Lester Leland,	250 00	Mrs. S. V. R. Crosby,	50 00
Walter D. Denegre,	250 00	The Misses Sturgis,	50 00
Harrison K. Caner,	250 00	William L. Putnam,	50 00
Mrs. W. Scott Fitz,	250 00	Alex. S. Porter, Jr.,	50 00
Francis M. Whitehouse,	250 00	Mrs. Greeley S. Curtis,	50 00
Mrs. Mary L. Blake,	200 00	Wm. A. Tucker,	50 00
Mrs. J. L. Bremer,	200 00	Mrs. James T. Fields,	25 00
T. Jefferson Coolidge, Jr.,	200 00	Russell Tyson,	25 00
Miss Amy Curtis,	200 00	Nelson S. Bartlett,	25 00
Mrs. Charles P. Hemenway,	150 00	J. H. Storer,	10 00
Robt. T. Paine, 2d,	150 00	Lee, Higginson & Co. (various contributions),	299 16
Samuel Carr,	100 00		
Dr. R. H. Fitz,	100 00		
S. H. Fessenden,	100 00	Total,	$8,434 16

Magnolia.

John Hays Hammond,	$500 00	Mrs. R. McM. Colfelt,	$100 00
John T. Morse, Jr.,	400 00	George A. Upton,	75 00
Wm. H. Coolidge,	250 00	George E. Carter,	50 00
Miss E. G. Houghton,	250 00	Mrs. Charles H. Bull,	50 00
Miss Faulkner,	200 00	Mrs. D. P. Williams,	50 00
Oceanside Hotel,	200 00	Mrs. I. Theodore Heard,	50 00
George F. Willett,	200 00	Charles S. Penhallow,	25 00
James S. Lee,	150 00	Georgina Lowell,	25 00
Edward C. Richardson,	100 00	Mrs. A. S. Covell,	10 00
William R. Nelson,	100 00		
J. Harrington Walker,	100 00	Total,	$2,985 00
Mrs. Mary D. Turnbull,	100 00		

Wood Roads.

Miss Mary Curtis, ... $25 00

South Shore Work.

Last spring it was thought that the towns and summer residents on the South Shore were to co-operate with the State, and carry on moth work similar to that in vogue on the North Shore for some years. In anticipation of this plan Mr. Walter F. Holmes,

The tree on the left is a sugar maple on a residential street, showing injury from teams and resultant decay. The tree on the right is the same, after treatment. The inside was hollow, but was filled from the two openings.

who has had much experience in the latter place, was transferred to Cohasset to superintend the work. For some reason the plans fell through, but it was thought best to keep Mr. Holmes in that section, and a new division was made there. From the year's work it is believed that the conditions are better than ever, although the results would have been much more satisfactory had the former arrangements been carried out.

City Forester.

The proper care of shade trees in our cities and towns is an economic question of great importance. While trees grow naturally throughout the State, and in the past they have needed little care, in recent years, due to many causes, they must be intelligently looked after if we expect to keep them healthy and vigorous. The importance of foreign depredations like insects and diseases has necessitated our having a knowledge of their habits and life histories as well as remedies for their control. The unbalancing of our conditions in cutting off forests, enlarging our cities and changing things generally in our development of the country are accountable for many of our troubles. The work of the Massachusetts Forestry Association, through its new endeavors in establishing branch organizations in different sections of the State and thereby stirring up new interest in the importance of better care of our trees, is resulting in the desire on the part of our people that more skill be employed. Secretary Reynolds has several competent men working in different sections along this line whose efforts are already showing good results.

Mr. W. W. Colton, a former employee of this department, has been city forester of the city of Fitchburg for the past two years, and as his accomplishments during this time have been extremely effective, I have prevailed upon him to prepare the following paper, believing it will prove of general interest: —

Work of a City Forester in Massachusetts.

Most of our Massachusetts cities have had some individual or some department that has looked after the interests of the shade trees. A few have had a man who held the office of city forester, but whose duties were only to trim and plant shade trees. The gradual change in conditions in the past few years added many duties to the office of city forester, until now it is a much more difficult position to fill than previously. The modern

city forester must be a man of special training, equipped to handle not only the old work but all the forestry and arboricultural interests of his city, such as establishing a nursery in which to raise the trees to plant his streets with, looking after the health and preservation of the older trees of the city, and being able to advise the citizens about their properties from a commercial as well as an æsthetic standpoint, and establishing and maintaining a municipal forest, the products of which will help run his department.

At the present time, however, the chief duty of a city forester is the care of shade trees. In taking over the position of forester in any city, the first duty is to obtain information in regard to his city and the condition of the trees there. To accomplish this he should first of all take a tree census, *i.e.*, all trees standing on public streets should be listed and a record of same kept at a central office for future reference. This work should be done as far as possible personally, as it gives him the personal acquaintance with his trees and their surroundings. After this information has been tabulated, and the forester has made himself familiar with his surroundings, his next step should be to get into the real work of putting the old trees into better condition, removing worthless specimens, and replacing and adding new trees to the streets. He should first of all obtain the services of a good active man of considerable experience in tree work to act as foreman, and then through this foreman put his own ideas into practice.

The question is often asked, "Why is it necessary to have a city forester at all? Why do we need to spend so much money on our shade trees? Cannot they take care of themselves as they have for centuries, without the necessity of having a high-salaried official to look after them? Our trees looked better twenty years ago, and with less care than they now have. Why is it?"

The answer is plain to one versed in the progress of modern events. Our entire mode of living has changed in the past half century; we live faster, we require more in everything. We are not satisfied with what we have been blessed with naturally but we wish for everything that we see others have. This same holds true about trees. We have not been satisfied with the species we find growing here naturally. We wish for some we have seen in Europe, Japan or China. This is only natural; it simply coincides with the progress of things in every branch of life. To satisfy this we have imported foreign trees, shrubs and flowers, and with these foreign plants we have also imported foreign diseases, which in their native countries are not fatal, as nature has there established a balance, and created parasites which in turn keep the pests down and preserve the trees. This sudden change, however, of the insect or disease from one climate to another often kills the parasite, or it is not imported, while the disease itself enters and becomes fatal to our trees. This accounts for practically all of our worst tree pests. The gypsy moth, brown-tail moth, elm-leaf beetle, San José scale, leopard moth, probably chestnut blight

disease and others have all been imported from some foreign country through our greed to have everything that some one else possesses.

The insect problem, nevertheless, has in a way been a benefit to us. It has brought to the notice of the people in general, through actual experience, the fact that a city or town without shade trees is a pretty poor place to live in. It has made them observe their trees, and has caused certain people to awake to the fact that trees, like any other living thing, cannot be set down in artificial conditions and expected to live on forever without some kind of nourishment and care.

There are a number of other items that enter into the cause of decline of our shade trees in the past quarter century, and especially so in our cities. The shade tree in most of our modern cities has a very hard life to live. Practically all the conditions under which it is forced to grow are entirely foreign to its natural element. The soil usually is not as good; it has in most cases been impoverished by continued use for agricultural purposes before it was cut up into building lots. In many cases the land has been made by filling in with ashes, stones and other refuse. In other cases the rich top soil has been removed to enable a grade to be established, the tree being set out originally in poor soil and handicapped from the very start. To add to this handicap, the atmospheric conditions are much different from what they used to be. The air is full of smoke, dust from oiled streets and noxious gases from various manufacturing plants. All these choke the lungs of the tree (its leaves) and cut off its supply of pure air. Add to this the fact that its roots are cut off when the road is regraded, again when the sidewalk is put in; that a tar or cement sidewalk and a macadam or paved street is put in around its roots and its water supply cut off. Then what chance has the poor tree of living?

To meet all these conditions the tree has to change its way of growing many times, and becomes almost an entirely different tree from the same species growing under natural conditions. Some species are not capable of doing this, and will therefore die and have to be removed. It has become necessary for us therefore to make a study of the species most capable of living under these adverse conditions and to replace the less desirable ones with these.

When a tree has all it can do to obtain nourishment enough to live on, it does not take much of a setback to allow the entrance of some disease, which once started quickly weakens the tree, allowing other diseases to take hold, which, combined, quickly prove fatal.

The familiar stag-headed effect, *i.e.*, the top of the trees dying, leaving only the lower limbs alive and green, is caused in most cases from lack of nourishment and moisture. This lack of moisture is not always caused from the absence of the proper elements in the soil, but from the weakening of the tree to such an extent that it is unable to assimilate it. The past few very dry summers have had their effect on the shade trees of all localities, and especially so with us on account of our topography. The dry, hot summer has almost stopped growth in the tree, and then the fall rains

have stimulated a late addition of cells which have not had time to properly harden off before the extreme cold weather has set in. This has caused a severe case of winterkilling of these new cells, resulting in the death of portions of the roots, thereby cutting down their ability to supply food to the tree and resulting in turn in the dying of the tops.

This condition has repeated itself for several years, and is, of course, something that cannot be helped, but the resulting condition of the trees can be aided by the proper care.

These are things liable to happen to perfectly healthy trees and those that have had the best of care, but in the case of the trees where no care has been taken, we find them to be in very poor condition to withstand it.

To give a concrete example of what may be accomplished along these lines, I am going to tell you what we have done in a small way here in Fitchburg.

In the tree directory kept by the city forestry department, it is shown that we have 1,937 trees belonging to the city or within the limits of the highway boundaries in the city proper. Of this number, 254 only are classed as perfect tops and 420 are perfect trunks, 577 are good tops and 597 good trunks, while 1,086 tops and 896 trunks are below that classed as poor or in bad condition.

Of the same number of trees we find the following defects present: 166 have cavities of more or less size which need tinning or cementing to keep the gypsy moth out and to prevent fungous diseases from entering; 26 have crotches or bad forks that need bracing by means of bolts or chains to ensure them against splitting; 180 have injuries of a more or less serious nature that need attention; 42 have boiler plate guards that are now injuring the trees and should be removed; 115 have wire guards that have been imbedded in the growing tree until they are girdling and killing it. Of the entire number of street trees only 289 have guards of any kind, and 173 of these need removing, so that practically all of our shade trees that stand near the curbing need new wireguards. Besides this work, many of the trees listed as dying or in poor or bad condition are in need of rejuvenation.

To give an illustration to the people of our city of what could and should be done with all shade trees in the city, the local branch of the Massachusetts Forestry Association made available a sum of money for our department which they stipulated was to be used on a certain street to put the trees there in the best possible condition under the circumstances.

A street was picked out that was centrally located and on which there were 29 trees, ranging in diameter from 15 to 25 inches and composed of 21 sugar maples, 6 American elms, 1 horse chestnut and 1 American linden. Not one of these trees was classified in our census as perfect, but a majority of them was in good or fair condition and 7 of them were in poor condition.

It was our aim to put all these trees in such condition that we could reclassify them as very good or perfect.

In order to do this we removed all the dead or dying limbs, cut off superfluous branches, and shaped the tree so that it would conform with its neighbors as near as possible; chained together limbs that were in danger

of splitting off in a heavy wind storm; removed the boiler plates and old wire guards that had outgrown their usefulness; opened up all cavities, cleaned out all the dead wood and refilled them; and lastly, removed the curbing and sidewalk that were choking the root and trunk growth of the tree, and put on new guards.

The first operation of removing the dead limbs is a very simple one, and one that every one has seen done many times. In this, however, and also when we remove the live limbs, great care is taken to make the cut as close to the trunk of the tree as possible, and to have it cut parallel to the axis of the tree. After the cut is made the resulting wound is carefully covered with tar, to prevent water and air from getting into the freshly exposed wood and starting decay anew.

The shaping of the tree is something that has to be left to the judgment of the foreman, as the conditions under which the tree is growing enter into the case very largely, and no set rule can be laid down.

After the tree has been relieved of its dead wood, and enough live wood removed to shape it as wanted, all the remaining limbs are carefully looked over for defects. If we find any cavities in them they are scraped out and cement put in, or the inside treated with creosote and then a piece of zinc or tin cut to exactly fit this hole and nailed over it, after being tarred on both sides to prevent the moisture from the live wood rusting it. If the limb is particularly weakened after the dead tissue is removed, then cement is usually used instead of tin, as this adds strength to the limb.

In many cases these limbs where they leave the main body of the tree are particularly weak (some have already started to crack), and show to the expert eye that they need bracing, in order to prevent them from splitting off during some wild storm and possibly injuring some passer-by, thereby causing not only inconvenience to some of our citizens but also the danger of the added expense of a lawsuit to the city. In order to prevent this, when we find a limb that in our opinion is dangerous it is braced by means of chains connecting it with some other stronger limb or with the main trunk. These chains are attached to the tree or limb by means of bolts or lugs set into the wood, and the chain attached to the bolts and not to the tree itself. This has the effect of holding the limbs in the position they are meant to assume, and yet it does not prevent them from swinging in the wind to some extent.

The old boiler plates and wire guards that were once attached to the trunks of the trees have in most cases long since passed their usefulness and now need to be removed. In the case of the wire guards, they were firmly nailed to the trunk of the tree, and as the tree has continued to grow the wire has naturally remained stationary, and therefore has become imbedded in the living tissue of the trunk. This has to be removed, or the tree stands in danger of being girdled or of being injured to such an extent that fungous and other diseases can find a lodgment and form new cavities. This same has been true, to a certain extent, with the boiler plate guards; they have become imbedded in the tree oftentimes to such an extent that it is almost impossible to remove them. In addition

to this trouble we have the danger of water settling behind these guards and causing serious decay; it is also an ideal lodging place for insects of all kinds, especially the gypsy moth. All these guards have been removed, and where it was found necessary the cavities behind them treated in the proper manner.

The method used in treating all the cavities was to remove every sign of decayed and decaying wood; then in case of a large cavity staples are driven into the wood near the edge of the wound and a wire screen cut to fit the opening fastened into place. A small space is reserved at the top, through which the first installment of cement is poured, this consists of a composition of cement, sand and coarse gravel. After this has set, the outside dressing of fine cement and sand is applied and the finishing touches are added. Great care has to be taken here not to have the cement overlap the cambium layer or growing part of the tree. After this has thoroughly set the whole thing is painted with tar. Before the cement is run into the hole, the wood is treated with creosote, to prevent its attack by the fungous ant, and to kill any that may not have been reached when the dead wood was being removed.

The last operation that we have had to do in the case of these trees is to place new wire guards around them, to remove the curbing where it is pressing too close to the tree and to remove the sidewalk for a given number of square inches around its base. From this place all the cobblestones and other refuse that have been used in construction of the sidewalk is removed and a fresh supply of loam put in its place. This gives the tree a chance to expand and grow, and a chance for a small amount of water and air to penetrate the earth. As a tree needs both of these elements for its continued health, we have done just so much more towards its accomplishment, and probably added several years of life to these trees.

All this work not only prolongs the life of the trees themselves but adds to the health and beauty of the street. Trees are not only beautiful to look at (when properly cared for), and an addition to any street, but are in themselves an addition to the health of that street, as they take up carbon dioxide and other noxious gases from the air, and after breaking this up and absorbing the carbon to make cellulose for their own tissue building, they give back to the atmosphere pure oxygen. They are also great equalizers of temperature, making it warmer in winter and cooler in summer, because of the great amount of water transpired through their leaves and cells. They are a benefit to the city which takes good care of them because they attract outsiders, and often are the cause of bringing new industries to your city.

So much for the shade-tree problem of a city forester. Besides this so-called tree surgery work, there are a number of diseases and insect pests to be handled and preventive methods used in caring for them.

Where the elm-leaf beetle is established, or where gypsy or brown-tail moths have obtained a foothold, a power sprayer outfit is very essential, and a well-defined spraying campaign should be carried out from early

A large cavity filled with cement and cobble stones, forming a cheap and serviceable filling.

Cavity in old apple tree cleaned out and covered with zinc. A hiding place for the gypsy moth closed. Note the new growth of one season covering the edges.

spring, when it is advisable to spray for scale insects, until August, when the most effective work can be accomplished against the brown-tail.

In carrying on the work against the gypsy moth, we divide it into two divisions, orchard and woodland work, each of which has its separate methods of procedure and is in turn divided into three classes of work.

Of course, the first object is to get the owner to do his own work and do it intelligently, but where this cannot be accomplished, we take the following method. If it be an orchard, our first work is to remove the worthless trees and then put the remaining ones in the best possible condition to withstand the pests. This can be done by removing the dead wood and closing all cavities within by means of the tin or zinc method, or cement. There are several methods of cementing which are cheaper but not as lasting as the ones described previously. A picture of one method is shown in this report. The large cavity is simply hurriedly cleaned of decayed matter and the outside edges pared down to give a free exposure of the cambium, then the cavity is filled with a composition of cement, sand and large stones, care being taken, of course, not to remove the cement composition over the cambium layer. The whole thing is then painted with tar. This affords a cheap filling for large cavities and at the same time prevents the laying of eggs out of sight or where they cannot be easily treated. Smaller cavities are treated as illustrated elsewhere in this report.

After the orchard has been put into this condition the owner is instructed to hunt the eggs of the gypsy moth and treat them with creosote, or the city does the work.

Owing to the topography of our city, and the great amount of loose stones, retaining walls and old stone walls, it is impossible to locate and treat all the egg clusters deposited, and a continuous infestation is therefore resulting, in spite of the elimination of the hollow trees. It therefore becomes necessary to use other means of holding them in check. For this reason spraying of orchards is advised, and the additional use of tanglefoot on the trees where they adjoin woodland infested with gypsy moths.

In the case of woodland, we advise also the removal of worthless specimens, or, in other words, an improvement thinning adapted to gypsy moth conditions. For this purpose we have published a list of trees which are more or less resistant to the gypsy moth and those nonresistant. It is then our policy in every case possible to remove not only suppressed and worthless trees, but also the nonresistant species.

Two examples of this work we conducted in our city last year. The first covered an area of about 6 acres and the second 50 acres. In the first case the work was done at a profit to the owner of some $200, and in the second case, where a considerable area of pine thinnings was made also, a profit of $1,300 was realized.

In the second stage of work in the case of woodland it does not seem profitable to go over the trees with creosote or use the tanglefoot only in rare instances, but spraying is conducted extensively.

In addition to the above-stated methods, which I designate as hand

methods, we are relying mostly for the controlling of the gypsy moths in the wood on the free use of diseases and parasites. In this latter method is our only hope for the future in controlling the pests.

In conclusion, I would say that I believe one of the important duties of the forester in cities of Massachusetts where we have such narrow streets is to see that through proper co-operation with land companies and the city departments the future plans for improvements on streets and the laying out of new ones should give attention to the establishing of a space for shade trees between the curb and the sidewalk. This gives a much more satisfactory effect and uniformity of planting to street trees, and at the same time affords the tree a much better chance of thriving than under the present conditions, where they are oftentimes placed partly in the street and partly in the sidewalk, or, in some cases, in the very middle of the sidewalk itself.

As shade trees have been proved to be a distinct addition to a city, together with increasing the value of property abutting, it would seem to be a good investment for any city or group of towns to employ the services of a trained forester, who can look after their interests not alone in regard to shade trees, but for the establishment of municipal forests for a future revenue.

Lectures and Addresses.

The State Forester has had the usual number of requests for engagements in the State and abroad, but his time has been so fully taken up that it has been impossible to do as much of this work as usual throughout the year.

The usual lectures on the State forest policy were given before the students at the Massachusetts Agricultural College during the winter.

The following organizations were addressed during the year: —

West Hampden Pomona Grange.
Norfolk Men's Association.
Worcester Horticultural Society.
Chicopee Board of Trade.
Men's Club, Hopedale.
Aberdeen Club.
Needham Farmers and Mechanics Club.
New Century Club, Mansfield.
Massachusetts Forestry Association.
Springfield Fish and Game Club.
Young Men's Christian Union.
State Board of Agriculture.
Taxation Convention.
District Fire Meeting, Walpole.
Economic Club.
Cape Ann Scientific and Literary Association.
Farmers' Institute, Warwick.
Massachusetts Agricultural College.
Chestnut Blight Convention, Harrisburg, Pa.
Boston Market Gardeners' Association.
St. James Men's Club, Roxbury.
Berkshire Public Lecture, Pittsfield.
Natural History Museum, Science Teachers.

One of the many trees in need of immediate attention.

Properly pruning and treating a street tree (elm). Trimming crew at top of 36-foot ladder; foreman at foot.

Pomona Grange, Medway.
Canton Lecture Course.
Fitchburg City Government.
Newton Men's Club.
Northfield Grange.
Grange, Southborough.
Amesbury Park Association.
Norfolk County Associated Board of Trade.
Public Meeting, Great Barrington.
Old Colony Pomona Grange, Easton.
State Grange Field Day, Monterey.
Old Colony Pomona, Dartmouth.
Cape Ann Literary and Scientific Society, Gloucester.
State Grange Field Day, Montague.
Pomona Grange, Billerica.
Men's Club, Hopedale.
Citizens' Meeting, Carver.
Firemen's Muster, Hanover.
State Grange Field Day, Pembroke.
Arbor Day Exercises, Winthrop.
State Grange Field Day, Templeton.
New England Tax Association.

Field Meetings of the State Grange.

No more potent factor exists for the uplift of humanity and the promotion and advancement of all contributory agencies to material prosperity in rural communities than the work of the order known throughout the country as the Patrons of Husbandry. Nearly every town and village in Massachusetts has its grange hall, where at stated intervals the members of the order gather and discuss questions of importance relating to the welfare of the nation, State or their local communities. The objects of the order are to aid in the development of everything which may add to the wealth and power of the nation, and bring to its people the fullest measure of comfort and happiness. In order to stimulate the interest of its members in all movements for the betterment of economic conditions in Massachusetts, the State master, Charles M. Gardner, this year arranged for and held a series of field meetings that were addressed by representatives of various State departments, each of whom spoke in detail of the work of his department. The State Forester's office was represented by the secretary, Charles O. Bailey, at the meetings held at Pembroke, Greenwich Village, Montague, Templeton, Monterey, Blandford, Sunderland and Dartmouth. The work of reforestation, the development of the forest fire system, and other branches of forestry were discussed by the speaker, and the decidedly marked interest manifested by the audience at each meeting was extremely gratifying, and must be regarded as an indication of the enthusiastic favor with which the forestry movement is held generally by the people of the Commonwealth.

Fourth National Conservation Congress.

The Fourth National Conservation Congress met at Indianapolis, Ind., October 1 to 4, and the State Forester was appointed a delegate by Governor Foss.

The Congress was a success, and from the forestry standpoint interest was aroused that promises for even greater accomplishments at future meetings. The lumbermen were well represented. Many of the State officials in forestry lines were present, and the work along forest fire protection and management was fully discussed.

While at this convention I was particularly fortunate in having an opportunity to go over the data accumulated by the Indiana State Forester relating to the catalpa tree. This tree is indigenous to Indiana. There has been so much written about it as being a tree well adapted to general forestry uses, particularly the *catalpa speciosa*, that I was pleased to obtain information I have much wished for. I find that this species, even in Indiana, is not considered commercially as valuable as many would make it. This corroborates our experience thus far with the catalpa in Massachusetts. We have several examples where the catalpa plantations have proved a failure.

Meeting of Eastern Foresters.

A meeting of the organization known as the Eastern Foresters, which is composed of the State officials and others engaged in teaching or professional forestry work in the eastern States, was held July 15 and 16 at Petersham, Mass., at the invitation of Professor Fisher of the Harvard Forest School. It proved to be the largest gathering ever held of the members, and the occasion gave an opportunity to study the Harvard forestry school methods and discuss State forest policies.

Financial Statements.

General Forestry.

In accordance with section 6, chapter 409 of the Acts of 1904, as amended by section 1, chapter 473 of the Acts of 1907, the following statement is given of the forestry expenditures for the year ending Nov. 30, 1912: —

Salaries of assistants,	$5,611 42
Traveling expenses,	1,431 85
Stationery, postage and other office supplies,	1,191 79
Printing,	461 57
Nursery account,	5,270 57
Sundries,	29 44
	$13,996 64

Reforestation.

Labor,	$6,042 22
Land,	1,250 90
Trees,	619 88
Tools and equipment,	350 83
Travel,	1,162 07
Express,	491 34
Sundries,	73 05
	$9,990 29

Forest Fire Prevention.

Salaries,	$5,341 14
Travel,	1,591 22
Printing,	1,066 85
Stationery, postage and other office supplies,	339 07
Express,	68 59
Equipment,	1,115 22
Construction,	814 88
Telephone,	322 70
Sundries,	5 74
	$10,665 41

Miscellaneous.

Salaries,	$5,095 46
Travel,	2,726 00
Printing,	168 24
Stationery, postage, and other office supplies,	128 29
Express,	102 35
Equipment,	257 51
Construction,	372 49
Telephone,	482 36
Sundries,	1 63
	$9,334 33

Reimbursement to towns for fire-fighting apparatus $4,989.99.

Moth Work.

The balance shown on the general appropriation for suppression work will be greatly reduced by reimbursements to cities and towns which have not yet made returns to this office of their final expenses for the year.

General Appropriation.

Balance on hand Nov. 30, 1911,	$116,103 44	
Less reimbursement due for 1911,	68,661 37	
Balance for 1912 work,	$47,442 07	
Receipts: —		
Appropriation for 1912,	150,000 00	
Town of Natick,	479 77	
Town of Great Barrington,	157 00	
Town of Rowley,	619 28	
Town of Norwell,	179 73	
Town of Hingham,	10 48	
Appropriation of Feb. 20, 1912,	100,000 00	
Town of Milton,	2,510 34	
Town of Wakefield,	658 37	
Town of Rockport,	126 95	
Town of Needham,	432 52	
Boston Brick Company,	526 89	
Transfer forest fire appropriation,	16 47	
Transfer forestry appropriation,	43 28	
Transfer reforestation appropriation,	215 49	
Transfer special North Shore fund,	14,389 08	
Transfer special South Shore fund,	16 49	
City of Marlborough,	679 25	
Chas. H. Chaplin for wood,	33 00	
Miss M. R. Case for work in Weston,	211 90	
Town of Topsfield,	559 61	
J. D. Barnes,	30 00	
		$319,337 97
Office expenses: —		
Salaries of clerks,	$2,598 91	
Rent of offices,	2,621 66	
Stationery and postage,	945 12	
Printing,	1,566 93	
Office and laboratory supplies,	653 21	
Office and laboratory sundries,	714 30	
Amounts carried forward,	$9,100 13	$319,337 97

Amounts brought forward,	$9,100 13	$319,337 97
Field expenses: —		
Wages of employees,	29,777 19	
Traveling expenses,	12,513 31	
Tools and supplies,	107,281 22	
Special work,	17,500 00	
Rent of supply store,	745 83	
Rent of shop,	250 00	
Equipment at store,	185 47	
Sundries, including teaming,	3,467 65	
Reimbursement to towns and cities,	35,343 17	
		216,163 97
Balance,		$103,174 00
Appropriation for 1913,		75,000 00
Balance on hand Nov. 30, 1912,		$178,174 00
Reimbursement for 1912, paid in December, 1912, and January, 1913,		61,016 06
Balance carried to 1913, for year 1913, including $75,000 appropriated in 1912,		$117,157 94

SPECIAL NORTH SHORE FUND.

Receipts.

Balance from 1911,	$1,412 46	
Deposit by F. W. Rane, State Forester,	5,000 00	
Deposit by W. D. Sohier, agent,	5,000 00	
Deposit by city of Beverly,	5,000 00	
Deposit by W. D. Sohier, agent,	5,000 00	
Deposit by town of Manchester,	5,000 00	
Deposit by W. D. Sohier, agent,	5,000 00	
Deposit by F. W. Rane, State Forester,	12,500 00	
Deposit by W. D. Sohier, agent,	2,500 00	
Cash received for work on private estates,	5,147 30	
		$51,559 76

Expenditures.

Wages of employees,	$29,319 56	
Traveling expenses,	1,289 36	
Rent,	221 00	
Supplies,	14,930 81	
Stationery and postage,	7 95	
Sundries, including teaming, etc.,	2,109 03	
		47,877 71
Balance on hand Nov. 30, 1912,		$3,682 05

Special South Shore Fund.

Receipts.

Balance from 1911,		$107 68

Expenditures.

Field supplies,	$16 49	
Field sundries,	25 00	
		41 49
Balance on hand Nov. 30, 1912,		$66 19

The following is a list of towns and cities, with amount of supplies for moth work furnished for the year ending Nov. 30, 1912: —

Acton,	$302 77	Halifax,	$7 31
Andover,[1]	2,543 15	Hamilton,	800 81
Arlington,	1,306 03	Hanover,[1]	2,026 04
Ashburnham,	32 64	Hanson,	137 54
Ashby,	52 45	Harvard,	439 66
Ashland,	87 49	Hingham,	1,240 35
Avon,	59 65	Holden,	72
Bedford,	1,801 59	Hopkinton,	58 82
Berkley,	21 48	Hubbardston,	19 26
Berlin,	68 96	Hudson,	81 23
Billerica,	458 23	Ipswich,[1]	2,300 70
Bolton,	139 55	Kingston,[1]	1,091 69
Boston,	7 20	Lancaster,	51
Boxborough,	318 55	Lenox,	72
Boxford,	212 00	Lexington,	1,425 61
Boylston,	28 74	Lincoln,	1,989 13
Burlington,	410 47	Littleton,	279 55
Canton,	1,408 56	Lowell,	22 14
Carlisle,	525 62	Lunenburg,	142 98
Carver,[1]	1,099 10	Lynn,[1]	1,361 72
Chelmsford,	650 92	Lynnfield,[1]	2,489 82
Cohasset,[1]	3,446 51	Marlborough,[1]	1,596 23
Concord,	1,014 57	Marshfield,[1]	2,356 49
Danvers,	447 46	Mashpee,	56 87
Dracut,[1]	1,851 12	Medford,	1,223 62
Dunstable,	122 43	Merrimac,	129 91
Duxbury,[1]	1,034 02	Methuen,	767 24
East Bridgewater,	6 43	Middleborough,	279 16
Easton,[1]	1,658 40	Middleton,	275 59
Essex,	95 55	Milton,	2,673 78
Fitchburg,	3 24	Natick,	48 15
Georgetown,	504 41	Newbury,[1]	2,181 07
Gloucester,	767 33	Newton,[1]	7,332 99
Great Barrington,	72	Norfolk,	176 97
Groton,[1]	2,033 58	North Andover,	655 34
Groveland,	154 80	North Reading,	974 30

[1] Received sprayers from the State, agreeing to pay one-half the cost.

Northborough,	$56 50	Stoughton,	$0 86
Norwell,	660 68	Stow,	227 12
Paxton,	6 84	Sudbury,[1]	1,978 38
Pembroke,	148 66	Tewksbury,[1]	1,994 84
Pepperell,[1]	1,895 23	Topsfield,	433 16
Phillipston,	6 84	Townsend,[1]	1,782 00
Plympton,	76 55	Tyngsborough,	187 35
Princeton,	18 54	Wakefield,	959 48
Quincy,	1,225 11	Walpole,[1]	1,629 76
Raynham,	25 67	Waltham,[1]	3,189 22
Reading,	1,569 93	Wayland,[1]	2,629 30
Rockport,	16 18	Wenham,	991 63
Rowley,	1,180 71	West Bridgewater,[1]	1,752 33
Royalston,	23 80	West Newbury,	303 80
Salisbury,	203 24	Westborough,	13 76
Sandwich,	34 10	Westford,	465 57
Saugus,	1,599 57	Westminster,	16 72
Scituate,	1,749 02	Weston,	2,618 95
Sherborn,	385 03	Westwood,[1]	1,628 30
Shirley,[1]	1,936 42	Wilmington,	1,017 18
Shrewsbury,	2 61	Winchester,[1]	1,970 77
Southborough,	237 10	Woburn,	1,290 31
Sterling,	1,675 31		
Stoneham,[1]	2,176 34		$105,310 51

Cities and towns,	$105,402 33
Experimental work,	23 77
Forestry department,	43 28
Forest fire prevention,	16 47
Malden Hospital,	29 50
North Shore fund,	16,389 08
Pine Banks,	159 43
Reforestation,	215 49
South Shore fund,	16 49
Traveling pump,	5 82
Traveling sprayer, (1),	21 56
Traveling sprayer, (2),	1 25
Traveling sprayer, (3),	54 33
Traveling sprayer, (4),	226 58
Traveling sprayer, (5),	13 53
Traveling sprayer, (6),	50 14
Traveling sprayer, (7),	172 32
United States Department of Agriculture,	34 65
	$122,784 20

Financial Summary by Towns of Moth Work.

The following table shows the reimbursement paid to cities and towns for the year 1911, the total net expenditure, the required expenditure before receiving reimbursement from the State, the amount of work on private property returned to this office, and the amount of reimbursement paid for 1912, with the required expenditure for 1913.

[1] Received sprayers from the State, agreeing to pay one-half the cost.

Towns and cities having an asterisk (*) against the amount of reimbursement for 1911 and 1912 also received supplies from the State supply store, as per list printed on page 87 in Part II. of the annual report for 1911 and on page 354 in this year's report.

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Abington,	-	$1,311 93	-	-	-	$1,361 05
Acton,	$1,002 88*	915 40	$1,913 25	$332 50	$997 85*	970 13
Acushnet,	-	382 38	-	-	-	402 86
Amesbury,	-	2,546 82	2,144 22	891 23	-	2,615 03
Andover,	759 87*	2,873 89	3,455 40	1,670 38	-*	2,883 11
Arlington,	21 81*	5,000 00	4,070 37	1,770 98	-*	5,000 00
Ashburnham,	-*	421 21	525 96	325 81	104 75*	488 17
Ashby,	232 33*	232 92	466 40	69 16	233 48*	239 32
Ashland,	69 13*	515 79	759 57	173 12	243 78*	585 00
Athol,	-	1,967 57	-	-	-	2,216 99
Attleborough,	-	5,000 00	-	-	-	5,000 00
Auburn,	-	537 60	-	-	-	554 00
Avon,	67 17*	396 94	518 96	108 71	122 02*	414 70
Ayer,	-	890 99	844 26	31 70	-	922 45
Barnstable,	-	3,150 59	-	-	-	3,175 20
Barre,	-	910 96	-	-	-	1,001 02
Bedford,	2,464 26*	600 77	2,897 57	1,886 33	2,296 80*	667 80
Bellingham,	-	373 67	-	-	-	383 65
Belmont,	572 26*	2,757 03	1,832 61	1,576 00	-	3,015 78
Berkley,	-	162 46	259 68	47 87	97 22*	165 77
Berlin,	881 82*	239 68	1,248 95	393 64	1,009 27*	243 10
Beverly,	316 83	5,000 00	4,544 26	1,979 52	-	5,000 00
Billerica,	651 75*	1,025 97	1,880 86	458 01	854 89*	1,132 00
Blackstone,	-	944 55	-	-	-	948 29
Bolton,	237 10*	234 32	1,107 08	114 95	872 76*	258 98
Boston,	20,000 00*	5,000 00	47,851 69	17,817 90	20,000 00*	5,000 00
Bourne,	-	2,277 02	-	-	-	2,881 49
Boxborough,	1,406 11*	114 43	1,436 42	111 36	1,321 99*	116 41
Boxford,	1,684 58*	586 74	2,638 94	329 03	2,052 20*	610 32
Boylston,	-	206 91	210 85[1]	191 70	-*	207 40
Braintree,	-	2,677 95	-	-	-	3,163 39
Brewster,	-	341 88	-	-	-	354 44

[1] No papers filed.

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Bridgewater,	$280 69*	$1,420 72	$1,123 90	$276 42	-	$1,447 26
Brockton,	-	5,000 00	-	-	-	5,000 00
Brookfield,	-	546 68	-	-	-	541 40
Brookline,	-*	5,000 00	-	-	-	5,000 00
Burlington,	2,310 25*	293 94	1,790 52	163 75	$1,496 58*	310 18
Cambridge,	-	5,000 00	-	-	-	5,000 00
Canton,	1,154 91*	2,044 39	2,336 35	1,469 47	291 96*	2,133 36
Carlisle,	2,373 26*	193 85	2,986 10	242 16	2,792 25*	191 37
Carver,	95 66*	808 23	1,623 05	440 24	489 82*	770 99
Charlton,	-*	539 58	-	-	-	522 40
Chelmsford,	464 74*	1,688 17	2,188 88	1,065 73	500 71*	1,753 60
Chelsea,	-	5,000 00	-	-	-	5,000 00
Clinton,	-	3,522 98	2,253 31	-	-	3,632 43
Cohasset,	1,153 29*	3,997 11	6,573 60	2,074 00	1,011 89*	3,802 02
Concord,	1,351 23*	3,088 80	4,724 04	2,469 97	1,105 28*	3,372 27
Danvers,	2,479 43*	2,644 15	4,377 42	1,393 52	1,297 13*	2,792 62
Dedham,	-	5,000 00	-	-	-	5,000 00
Dennis,	-	516 50	-	-	-	530 67
Douglas,	-	542 80	-	-	-	551 50
Dover,	954 89	2,347 82	-[1]	-	-	2,515 57
Dracut,	878 45*	990 92	1,888 24	956 25	297 32*	1,013 87
Dudley,	-	766 99	-	-	-	794 74
Dunstable,	878 77*	193 81	990 52	265 80	796 71*	170 36
Duxbury,	208 03*	948 11	1,530 81	718 42	257 70*	1,268 83
East Bridgewater,	399 63*	897 49	954 03	275 58	56 54*	903 05
Easton,	-	2,395 75	2,725 42	1,141 09	-*	2,408 14
Essex,	850 23*	524 64	1,127 95	418 75	603 31*	496 97
Everett,	-	5,000 00	1,830 06	-	-	5,000 00
Fairhaven,	-	1,509 81	-	-	-	1,554 84
Falmouth,	-	3,604 88	-	-	-	4,718 70
Fitchburg,	-*	5,000 00	-	-	-*	5,000 00
Foxborough,	-	985 74	-	-	-	1,033 04
Framingham,	-	5,000 00	3,444 23	-	-	5,000 00
Franklin,	-	1,731 40	-	-	-	1,773 40
Gardner,	-	3,806 52	-	-	-	4,005 63
Georgetown,	1,516 45*	505 10	1,963 58	678 68	1,458 48*	498 01
Gloucester,	675 33*	5,000 00	9,013 46	2,389 21	1,623 07*	5,000 00

[1] No papers filed.

Cities and Towns.	1911. Re-imbursement.	1912. Required Expenditure.	1912. Total Net Expenditure.	1912. Private Work.	1912. Re-imbursement.	1913. Required Expenditure.
Grafton, ...	–	$1,144 11	–	–	–	$1,168 22
Great Barrington, . .	–	2,509 28	–	–	–*	2,536 84
Greenfield, . . .	–	4,029 76	–	–	–	4,324 33
Groton, ...	$390 12*	1,588 66	$2,170 36	$451 01	–*	1,645 19
Groveland, . . .	961 44*	487 34	1,407 67	364 74	$920 33*	486 64
Halifax, ...	431 86*	255 53	693 93	499 55	438 40*	260 10
Hamilton, . . .	734 96*	1,728 38	2,763 91	992 82	1,035 53*	1,874 57
Hanover, . . .	760 18*	622 22	2,080 19	627 78	857 97*	638 09
Hanson, ...	552 58*	531 87	1,448 23	248 76	916 36*	551 32
Harvard, ...	1,033 69*	630 22	1,164 00	523 80	533 78*	680 53
Haverhill, . . .	108 28*	5,000 00	4,152 27	1,473 88	–	5,000 00
Hingham, . . .	–*	3,140 99	3,254 23	1,606 43	–*	3,116 37
Holbrook, . . .	–	598 23	–	–	–	639 20
Holden, ...	–	685 23	–	–	–*	712 78
Holliston, . . .	–	791 74	–	–	–	787 43
Hopedale, . . .	–	1,975 15	–	–	–	2,365 45
Hopkinton, . . .	–	655 65	–[1]	–[1]	–[1]*	702 60
Hubbardston, . . .	–	277 09	–	–	–*	307 48
Hudson, ...	298 52*	1,589 83	1,839 48	622 93	249 65*	1,618 63
Hull, ...	–	2,788 01	–	–	–	3,039 23
Ipswich, ...	1,493 55*	2,257 54	2,831 94	1,185 67	24 40*	2,295 12
Kingston, . . .	495 92*	747 58	1,296 63	463 53	224 05*	660 18
Lakeville, . . .	–	336 06	–	–	–	426 08
Lancaster, . . .	–	1,868 90	–	–	–*	2,140 57
Lawrence, . . .	–	5,000 00	–	–	–	5,000 00
Leicester, . . .	–	976 07	–	–	–	972 41
Lenox, ...	–	3,065 13	–	–	–*	3,133 87
Leominster, . . .	–*	5,000 00	–	–	–	5,000 00
Lexington, . . .	2,050 34*	3,182 90	6,724 89	1,969 93	2,548 47*	3,242 41
Lincoln, ...	–*	1,440 09	1,886 36	2,356 19	448 27*	1,615 75
Littleton, . . .	949 82*	459 41	1,336 14	88 80	876 73*	467 68
Lowell, ...	109 39*	5,000 00	4,133 66	3,439 09	–*	5,000 00
Lunenburg, . . .	661 04*	501 74	1,368 18	692 40	866 44*	534 53
Lynn, ...	–	5,000 00	1,156 50	3,036 21	–*	5,000 00
Lynnfield, . . .	1,650 93*	437 07	2,226 36	492 98	1,189 29*	479 72
Malden, ...	–	5,000 00	–	–	–	5,000 00
Manchester, . . .	–	5,000 00	–	–	–	5,000 00

[1] Work financed by State Forester's office.

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Mansfield,	-	$1,797 57	-	-	-	$1,672 18
Marblehead,	-	3,700 69	$2,042 15	$1,446 75	-	4,079 57
Marion,	-	2,187 92	-	-	-	2,065 46
Marlborough,	-	4,139 61	4,341 89[1]	-	-*	4,278 62
Marshfield,	$787 51*	966 60	2,008 77	1,134 17	$442 17*	1,064 55
Mashpee,	876 87*	94 60	845 33	112 67	750 73*	97 33
Mattapoisett,	-	847 83	-	-	-	798 62
Maynard,	-*	1,593 12	-	-	-	1,632 04
Medfield,	-	649 45	-	-	-	676 33
Medford,	-*	5,000 00	5,846 90	2,776 70	-*	5,000 00
Medway,	-	607 47	413 30	144 00	-	686 51
Melrose,	-	5,000 00	2,113 39	369 90	-	5,000 00
Mendon,	-	290 36	-	-	-	275 41
Merrimac,	778 08*	528 80	1,511 11	287 86	982 31*	535 89
Methuen,	59 92*	3,034 46	3,693 23	2,318 04	373 57*	3,194 64
Middleborough,	719 55*	1,916 35	2,609 47	1,296 42	693 12*	1,939 92
Middleton,	946 80*	340 18	1,629 50	290 13	1,289 32*	354 60
Milford,	-	3,812 48	-	-	-	3,954 62
Millbury,	-	1,123 31	-	-	-	1,193 41
Millis,	-	463 75	-	-	-	539 09
Milton,	-*	5,000 00	4,364 28	9,274 71	-*	5,000 00
Nahant,	-	3,543 50	-	-	-	3,673 72
Natick,	-*	3,312 66	2,605 61	2,172 80	-*	3,479 07
Needham,	-*	2,769 37	2,479 97	1,823 48	-	2,926 47
New Bedford,	-	5,000 00	-	-	-	5,000 00
Newbury,	2,342 80*	524 34	2,262 04	655 92	1,137 70*	627 06
Newburyport,	-	5,000 00	-	-	-	5,000 00
Newton,	5,994 96*	5,000 00	17,621 73	18,725 41	2,644 37*	5,000 00
Norfolk,	-	366 28	602 72	230 56	236 44*	418 44
North Andover,	709 22*	2,163 16	-[2]	-	-*	2,211 81
North Attleborough,	-	3,591 39	-	-	-	3,665 74
North Reading,	2,240 51*	299 56	2,228 50	642 86	1,923 94*	354 10
Northborough,	-	557 81	1,347 72	268 78	789 91*	566 66
Northbridge,	-	1,958 94	-	-	-	2,086 30
Norton,	-	555 78	-	-	-	601 74
Norwell,	-*	457 37	860 72	1,461 01	403 35*	446 38
Norwood,	-	5,000 00	-	-	-	5,000 00

[1] No papers filed. [2] Complete returns not yet filed.

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Oakham,	–	$147 96	–	–	–	$152 32
Orange,	–	1,620 19	–	–	–	1,652 94
Orleans,	–	607 60	–	–	–	765 33
Oxford,	–	797 74	–	–	–	820 58
Palmer,	–	1,887 59	–	–	–	1,934 07
Paxton,	–	155 27	–	–	–*	153 36
Peabody,	–	4,824 90	$6,932 14	$837 89	$1,685 79	5,000 00
Pembroke,	$1,039 19*	383 29	1,749 38	403 54	1,366 09*	390 54
Pepperell,	1,078 70*	923 79	2,004 49	468 35	480 70*	907 45
Petersham,	–	450 91	–	–	–	442 07
Phillipston,	–	116 10	–	–	–*	114 78
Plainville,	–	337 82	–	–	–	342 66
Plymouth,	–	4,720 83	–	–	–	4,886 83
Plympton,	1,246 08*	159 28	1,659 81	237 55	1,500 53*	166 36
Princeton,	–	551 91	–	–	–*	568 21
Provincetown,	–	883 52	–	–	–	915 41
Quincy,	647 75	5,000 00	3,697 12	1,945 64	–*	5,000 00
Randolph,	–	1,033 22	–	–	–	1,092 40
Raynham,	86 50*	318 46	770 57	139 12	452 11*	354 45
Reading,	822 74*	2,537 43	3,459 08	2,415 46	423 33*	2,618 75
Rehoboth,	–	372 53	–	–	–	385 80
Revere,	–	5,000 00	–	–	–	5,000 00
Rochester,	–	290 70	–	–	–	379 92
Rockland,	–	1,765 40	–	–	–	1,931 05
Rockport,	–*	1,464 25	1,910 81	959 00	446 56*	1,512 99
Rowley,	424 70*	1,132 50	1,830 57	134 12	698 07*	968 80
Royalston,	–	282 17	185 21	161 26	–*	278 44
Rutland,	–	318 40	–	–	–	312 59
Salem,	43 25	5,000 00	–	–	–	5,000 00
Salisbury,	1,046 91*	395 21	1,660 50	282 34	1,265 29*	535 99
Sandwich,	150 22*	463 12	620 91	244 12	157 79*	473 83
Saugus,	2,497 56*	2,356 02	5,312 44	1,458 19	2,956 42*	2,537 20
Scituate,	4,199 67*	1,972 23	6,018 60	1,375 00	4,046 37*	2,052 80
Seekonk,	–	566 58	–	–	–	499 89
Sharon,	–	1,284 47	–	–	–	1,287 25
Sherborn,	643 68*	604 25	903 38	895 35	299 13*	644 53
Shirley,	203 93*	491 91	1,127 25	133 80	–*	501 98
Shrewsbury,	–	770 21	–	–	–*	960 50

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Somerville,	–	$5,000 00	–	–	–	$5,000 00
Southborough,	$314 66*	791 73	$1,473 99	$1,045 76	$682 26*	822 60
Spencer,	–	1,412 37	–	–	–	1,459 18
Springfield,	–	5,000 00	–	–	–	5,000 00
Sterling,	665 57*	478 13	1,002 12	212 60	–*	493 86
Stockbridge,	–	1,659 75	–	–	–	1,813 78
Stoneham,	349 50*	2,043 71	–[1]	–	–*	2,104 35
Stoughton,	–	1,459 62	–	–	–*	1,557 35
Stow,	903 91*	414 85	1,333 23	304 64	918 38*	424 82
Sturbridge,	–	440 62	–	–	–	407 65
Sudbury,	1,370 29*	531 46	2,012 08	592 20	880 62*	544 28
Sutton,	–	587 32	–	–	–	618 05
Swampscott,	–	4,728 81	–	–	–	4,955 16
Swansea,	–	666 79	–	–	–	662 11
Taunton,	–	5,000 00	–	–	–	5,000 00
Templeton,	–	673 26	–	–	–	729 96
Tewksbury,	1,266 25*	583 27	1,778 03	570 75	594 76*	605 54
Topsfield,	1,045 21*	857 61	852 13	{ 559 61 1,006 17 }	–[2]*	1,243 95
Townsend,	365 61*	528 84	1,516 04	322 52	387 20*	538 96
Truro,	–	157 21	–	–	–	157 91
Tyngsborough,	1,480 47*	254 54	1,078 52	1,111 74	823 98*	262 14
Upton,	–	456 76	–	–	–	474 22
Uxbridge,	–	1,473 26	–	–	–	1,413 00
Wakefield,	–*	4,010 72	2,894 61	2,264 76	–*	4,372 26
Walpole,	–	2,391 00	2,370 85	693 80	–*	2,573 82
Waltham,	1,346 21*	5,000 00	8,666 81	5,531 20	238 80*	5,000 00
Wareham,	–	2,087 48	–	–	–	2,212 11
Warren,	–	800 29	–	–	–	840 79
Warwick,	–	179 81	–	–	–	165 89
Watertown,	–	5,000 00	–	–	–	5,000 00
Wayland,	1,044 94*	1,152 62	2,463 55	963 97	710 93*	1,270 83
Webster,	–	3,487 02	–	–	–	3,482 36
Wellesley,	–	5,000 00	5,740 22	2,910 54	370 11	5,000 00
Wellfleet,	–	410 67	–	–	–	407 46
Wenham,	1,577 97*	999 67	1,987 61	726 86	987 04*	1,051 16
West Boylston,	–	353 82	–	–	–	378 60
West Bridgewater,	434 48*	561 81	927 37	444 46	–*	613 84
West Newbury,	1,128 34*	425 49	1,444 83	402 23	1,019 34*	423 04

[1] Complete returns not filed yet.

[2] Work financed by State Forester's office.

Cities and Towns.	1911. Re-imburse-ment.	1912. Required Expendi-ture.	1912. Total Net Expendi-ture.	1912. Private Work.	1912. Re-imburse-ment.	1913. Required Expendi-ture.
Westborough,	–	$1,311 05	$1,246 66	$408 20	–*	$1,293 07
Westford,	$1,555 98*	829 36	2,259 31	371 87	$1,429 95*	859 24
Westminster,	154 49	352 48	482 95	228 95	130 47*	377 73
Weston,	1,354 28*	3,112 89	4,536 95	4,446 02	615 46*	3,359 89
Westwood,	–	1,409 36	1,063 98	294 13	–*	1,641 04
Weymouth,	–	3,461 62	3,472 86	1,519 50	8 99	3,982 86
Whitman,	–	2,172 46	–	–	–	2,215 37
Wilmington,	2,232 16*	642 15	2,694 31	701 07	2,052 16*	683 73
Winchendon,	–	1,659 88	1,154 35[1]	153 70	–	1,683 77
Winchester,	–	5,000 00	2,313 30	2,560 00	–*	5,000 00
Winthrop,	–	5,000 00	–	–	–	5,000 00
Woburn,	3,509 87*	4,624 55	8,729 52	1,290 66	3,025 92*	4,660 11
Worcester,	–*	5,000 00	–	–	–	5,000 00
Wrentham,	–	541 37	–	–	–	560 48
Yarmouth,	–	942 63	–	–	–	989 19

[1] No papers filed.

Legislation.

Except strengthening and perfecting several of the existing laws by amendments, the last Legislature enacted only one piece of important legislation relating to forestry.

The widespread interest on the part of Massachusetts citizens in the work of reforestation, and the desire of many to utilize their waste lands in the most profitable way, has been followed by a general demand for knowledge regarding the matter of obtaining seedlings, the cost of the same, and, in many cases, complaints on account of inability to purchase them at reasonable prices. These facts prompted the State Forester to consider the advisability of establishing State nurseries on lands owned by the Commonwealth at State institutions, where the labor of the inmates could be used without expense, thus enabling the production of nursery stock at a price well within the means of anybody desiring to purchase it. A bill providing for the creation of such nurseries, under certain conditions, was passed and approved. The act reads as follows: —

An Act relative to the Establishment of Forest Tree Nurseries upon Land of the Commonwealth.

Be it enacted, etc., as follows:

Section 1. Chapter four hundred and nine of the acts of the year nineteen hundred and four is hereby amended by striking out section three and inserting in place thereof the following: — *Section 3.* The state forester may establish and maintain nurseries for the propagation of forest tree seedlings upon such lands of the commonwealth, at the Massachusetts Agricultural College at Amherst, or at any other state institution, as the superintendent or trustees of the institution may set apart for this purpose. Superintendents of institutions where land is set apart for this purpose may furnish free of cost the labor of their inmates necessary to establish and maintain the said nurseries. Seedlings from these nurseries shall be furnished to the commonwealth without expense for use upon reservations set aside for the propagation of forest growths for other than park purposes. All stock grown in nurseries established under the provisions of this act shall be used within the limits of the commonwealth and shall be furnished to state institutions free of charge. The state forester may distribute seeds and seedlings to land owners, citizens of the commonwealth, under such conditions and restrictions as he may determine, subject to the approval of the governor and council.

Section 2. This act shall take effect upon its passage. [*Approved May 11, 1912.*

Summary of Recommendations of the State Forester.

1. That the general plan suggested and carried out last year regarding the moth work be continued this year, namely, that the appropriation be reduced $50,000 from last year, making the sum $200,000 for 1913.

2. That towns having a valuation of $2,000,000 or less be reimbursed by the State for one-half the expense in fighting forest fires.

3. That an increased appropriation be made to carry on the work of reforestation.

4. That the present forest fire permit law be amended so as to make it apply to all the cities and towns of the Commonwealth.

5. That the office of tree warden in towns be made an appointive office by the selectmen, instead of elective, as at present.

6. That legislation be enacted regulating the disposal of slash or brush, following wood and lumbering operations.

7. That the time of appointment of forest wardens and local moth superintendents be changed from "March or April" to January, in order to give sufficient time to organize for spring work.

8. The passage of a law requiring portable sawmills to be equipped with suitable devices to prevent the escape of sparks or cinders.

Respectfully submitted,

F. W. RANE,
State Forester.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH

MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1912.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held invested as Capital Stock. (R. L. 124, Sects. 3 and 12.)	Total Assets.	Real Estate.	Notes.
1	Amesbury and Salisbury (Agricultural and Horticultural),	1881	$1,002 32	[1] $8,220 97	$8,330 34	$7,716 69	–
2	Barnstable County,	1844	1,740 00	[3] 11,591 55	12,007 39	9,000 00	–
3	Blackstone Valley,	1884	3,000 00	[5] 8,700 00	9,085 37	8,700 00	–
4	Deerfield Valley,	1871	4,094 01	[1] 9,750 00	9,883 30	9,500 00	–
5	Eastern Hampden,	1856	3,000 00	[5] 19,300 00	19,518 02	19,300 00	–
6	Essex,	1818	4,527 20	[6] 15,662 87	15,662 87	15,300 00	–
7	Franklin County,	1850	3,768 00	[6] 17,687 11	17,687 11	16,025 00	–
8	Hampshire,	1814	3,255 26	[1] 5,050 00	5,082 04	5,000 00	–
9	Hampshire, Franklin and Hampden,	1818	8,141 29	[1] 29,110 00	30,267 94	28,610 00	–
10	Highland,	1859	3,262 00	[1] 3,120 00	3,154 01	3,000 00	–
11	Hillside,	1883	3,113 32	[8] 5,695 27	5,701 48	5,250 00	–
12	Hingham (Agricultural and Horticultural),	1867	17,406 15	[8] 4,489 20	4,489 20	2,500 00	–
13	Hoosac Valley,	1860	2,006 00	[5] 15,000 00	16,072 20	15,000 00	–
14	Housatonic,	1848	6,335 33	[6] 28,880 73	28,880 73	24,849 37	–
15	Lenox Horticultural,	1910	1,000 00	[9] 2,253 97	2,618 82	–	–
16	Marshfield (Agricultural and Horticultural),	1867	3,755 33	[1] 14,000 00	17,764 24	13,500 00	–
17	Martha's Vineyard,	1859	4,552 17	[10] 5,044 11	5,044 11	2,750 00	$80 00
18	Massachusetts Horticultural,	1829	525 00	[12] 847,195 10	857,194 43	518,564 63	
19	Massachusetts Society for Promoting Agriculture,[13]	1792	–	–	–	–	–
20	Middlesex North,	1855	3,000 00	[14] 6,802 73	7,031 64	–	3,888 80
21	Middlesex South,	1854	3,000 00	[1] 12,200 00	12,347 53	12,000 00	–
22	Nantucket,	1856	3,500 00	[15] 3,239 15	3,239 15	3,200 00	–
23	Oxford,	1888	4,400 00	[8] 11,694 79	11,694 79	11,000 00	–
24	Plymouth County,	1819	9,550 00	[9] 2,173 04	2,173 04	–	–
25	Quannapowitt,	1909	1,000 00	[1] 34,150 00	34,655 00	33,800 00	–
26	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[1] 10,350 00	10,374 78	9,400 00	–
27	Union (Agricultural and Horticultural),	1867	4,447 23	[1] 9,000 00	9,153 70	8,000 00	–
28	Weymouth (Agricultural and Industrial),	1891	10,270 00	[1] 12,270 00	12,817 18	12,000 00	–
29	Worcester,	1818	7,730 00	[8] 95,568 62	95,568 62	81,947 22	–
30	Worcester East,	1890	2,296 23	[1] 12,491 30	13,111 62	11,534 00	–
31	Worcester North (Agricultural and Driving Association),	1910	3,602 63	[9] 2,510 44	2,678 06	–	–
32	Worcester Northwest (Agricultural and Mechanical Association),	1867	3,400 00	[8] 13,326 37	13,326 37	13,000 00	–
33	Worcester South,	1855	3,127 40	[8] 22,309 23	22,309 23	21,000 00	–
34	Worcester County West,	1851	3,175 00	[1] 10,500 00	10,584 33	10,000 00	–
			$141,015 87	$1,309,336 55	$1,329,508 64	$932,446 91	$3,968 80

[1] Invested in real estate, crockery, tables, etc.

[2] Includes note for $216.49.

[3] Invested in real estate, trust funds, crockery, tables, etc.

[4] Trust funds.

[5] Invested in real estate.

[6] Invested in real estate, stocks, bank funds, crockery, tables, etc.

[7] Notes.

[8] Invested in real estate, bank funds, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1912.

Stocks and Bonds.	Bank Funds.	Crockery, Tables, etc.	Bills due and unpaid.	Cash on Hand.	Total Liabilities.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	
–	–	$504 28	–	$109 37	$1,716 49	–	–	[2] $1,716 49	$2,978 37	1
–	[4]$2,031 55	560 00	$45 00	370 84	5,482 30	$282 30	–	5,200 00	12,196 55	2
–	–	–	–	385 37	2,635 00	–	–	2,635 00	4,282 45	3
–	–	250 00	48 05	85 25	500 00	–	–	500 00	2,769 80	4
–	–	–	141 25	76 77	7,377 90	–	$1,417 90	5,960 00	7,900 79	5
$90 00	–	200 00	–	72 87	11,600 00	–	–	11,600 00	3,573 13	6
1,000 00	412 11	250 00	–	–	1,600 00	–	300 00	1,300 00	8,860 76	7
–	–	50 00	20 00	12 04	2,084 38	25 00	179 48	1,879 90	2,564 71	8
–	–	500 00	631 25	526 69	3,701 25	101 25	–	3,600 00	15,538 59	9
–	–	120 00	34 01	–	225 00	–	–	[7] 225 00	1,372 45	10
–	80 27	365 00	–	6 21	83 00	–	83 00	–	1,784 53	11
–	1,089 20	900 00	–	–	–	–	–	–	887 11	12
–	–	–	–	1,072 20	9,000 00	–	–	9,000 00	7,316 27	13
500 00	1,000 00	425 00	–	2,106 36	1,050 00	–	50 00	1,000 00	14,741 55	14
–	1,903 97	350 00	–	364 85	–	–	–	–	1,234 28	15
–	–	500 00	–	3,764 24	2,513 30	13 30	–	[7] 2,500 00	12,298 41	16
–	2,014 11	200 00	–	–	250 00	–	[11] 250 00	–	1,202 10	17
274,020 00	–	54,610 47	–	9,999 33	–	–	–	–	23,049 55	18
–	–	–	–	–	–	–	–	–	–	19
–	2,913 93	–	–	228 91	158 00	108 00	50 00	–	959 57	20
–	–	200 00	50 00	97 53	11,791 04	250 00	361 41	11,179 63	6,309 13	21
–	–	–	–	39 15	100 00	–	–	[7] 100 00	1,773 45	22
–	–	632 60	–	62 19	2,700 00	–	–	[16] 2,700 00	4,460 32	23
–	2,132 21	39 00	–	1 83	–	–	–	–	546 71	24
–	–	350 00	505 00	–	14,845 30	–	1,845 30	13,000 00	3,937 16	25
–	–	950 00	17 50	7 28	2,263 00	–	38 00	2,225 00	3,369 74	26
–	–	1,000 00	–	153 70	908 50	8 50	–	900 00	2,802 67	27
–	–	270 00	–	547 18	4,200 00	–	100 00	4,100 00	4,214 03	28
–	11,286 81	1,938 36	–	396 23	1,000 00	–	–	1,000 00	35,458 84	29
–	620 32	957 30	–	–	–	–	–	–	10,938 87	30
–	21,000 00	410 44	–	167 62	–	–	–	–	8,196 05	31
–	26 37	300 00	–	–	5,686 00	36 00	–	5,650 00	8,394 33	32
–	659 23	650 00	–	–	1,043 73	220 23	123 50	[7] 700 00	8,965 09	33
–	–	500 00	–	84 33	325 78	–	325 78	–	4,892 68	34
$275,610 00	$47,170 08	$67,982 45	$1,492 06	$20,738 34	$94,839 97	$1,044 58	$5,124 37	$88,671 02	$229,770 04	

[9] Invested in bank funds, crockery, tables, etc.

[10] Invested in real estate, notes, bank funds, crockery, tables, etc.

[11] Estimated.

[12] Invested in real estate, library, stocks, bonds, crockery, tables, etc.

[13] Represented on the Board by special enactment, and makes no returns.

[14] Invested in notes and bank funds.

[15] Invested in real estate and bank funds.

[16] Includes note for $200.

FINANCIAL RETURNS OF THE INCORPORATED SOCIETIES

	SOCIETIES.	Bounty.	Income from Notes and Bank Funds.	Income from Stocks and Bonds.	New Members.	Donations.	Entry Fees.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$714 31	–	–	$3 00	$65 40	–
2	Barnstable County,	800 00	$36 00	–	30 00	32 50	$45 00
3	Blackstone Valley,	736 86	–	–	11 00	–	158 00
4	Deerfield Valley,	800 00	–	–	47 00	–	165 00
5	Eastern Hampden,	800 00	–	–	93 00	–	758 00
6	Essex,	428 00	60 73	–	39 00	205 00	70 25
7	Franklin County,	800 00	–	$20 00	–	–	585 00
8	Hampshire,	621 40	–	–	17 50	309 45	210 00
9	Hampshire, Franklin and Hampden,	800 00	–	–	65 00	–	465 00
10	Highland,	654 05	–	–	61 00	–	50 60
11	Hillside,	800 00	18 00	–	79 00	–	–
12	Hingham (Agricultural and Horticultural),	619 60	41 36	–	55 00	29 25	–
13	Hoosac Valley,	800 00	–	–	–	–	255 00
14	Housatonic,	800 00	18 56	25 00	356 00	–	1,497 50
15	Lenox Horticultural,	548 50	80 88	–	8 00	190 00	–
16	Marshfield (Agricultural and Horticultural),	800 00	–	–	85 00	5 00	[4] 90 00
17	Martha's Vineyard,	606 30	85 94	–	10 00	1 00	–
18	Massachusetts Horticultural,	800 00	–	11,985 00	800 00	1,039 80	–
19	Massachusetts Society for Promoting Agriculture,[7]	–	–	–	–	–	–
20	Middlesex North,	663 95	292 62	–	3 00	–	–
21	Middlesex South,	800 00	–	–	37 00	213 60	812 67
22	Nantucket,	618 75	–	–	38 00	10 65	129 00
23	Oxford,	800 00	–	–	50 00	–	628 80
24.	Plymouth County,	401 70	90 01	–	5 00	–	–
25	Quannapowitt,	–	–	–	–	[8] 167 08	[9] 427 50
26	Spencer (Farmers' and Mechanics' Association),	800 00	–	–	10 00	73 06	467 15
27	Union (Agricultural and Horticultural),	800 00	–	–	27 00	–	199 50
28	Weymouth (Agricultural and Industrial),	580 15	–	–	–	58 48	320 00
29	Worcester,	800 00	556 45	–	145 00	750 00	2,454 60
30	Worcester East,	800 00	–	–	27 00	1,650 00	53 50
31	Worcester North (Agricultural and Driving Association),	431 99	125 86	–	10 00	90 50	1,122 50
32	Worcester Northwest (Agricultural and Mechanical Association),	800 00	–	–	35 00	10 00	542 31
33	Worcester South,	800 00	–	–	43 00	20 00	724 00
34	Worcester County West,	800 00	–	–	5 00	500 00	279 50
		$22,825 56	$1,406 41	$12,030 00	$2,194 50	$5,420 77	$12,510 38

[1] Automobiles and teams.
[2] Two notes.
[3] Annual dues.
[4] Trotting not included.
[5] Includes grand stand receipts.
[6] Estimated.

FOR THE YEAR ENDING DEC. 31, 1912 — *Concluded.*

Gate Receipts.	Grand Stand Receipts.	Concessions and Rentals.	All Other Sources.	Total Expenditures.	Premiums and Gratuities.	New Buildings and Repairs.	Current Running Expenses.	Interest.	All Other Expenses.	
$1,521 45	$18 70	$440 50	$215 01	$2,869 16	$959 50	$363 70	$409 22	$90 15	$1,046 59	1
5,883 50	2,115 40	1,037 00	2,217 15	11,825 71	961 30	1,063 60	6,508 73	438 50	2,853 58	2
1,697 75	1,108 50	142 80	427 51	3,937 05	802 35	1,187 39	1,588 07	65 00	291 24	3
1,386 40	125 75	232 50	13 15	2,684 55	1,460 80	–	992 47	27 75	203 53	4
3,888 30	727 25	1,155 94	[1] 478 30	8,065 27	1,238 18	–	6,505 12	321 97	–	5
1,380 92	–	281 23	1,105 00	3,579 15	1,031 00	210 17	612 83	570 69	1,154 16	6
4,563 25	757 56	878 20	1,256 75	8,469 39	2,888 80	146 75	4,016 88	118 44	1,298 52	7
783 75	67 00	111 00	414 61	2,565 01	1,062 55	125 94	375 89	117 78	882 85	8
8,840 74	1,687 50	3,092 80	587 55	15,011 90	2,956 25	2,976 71	5,383 25	294 37	3,491 32	9
214 15	–	58 75	333 90	1,338 44	912 95	–	392 99	7 50	25 00	10
546 85	60 85	216 55	63 28	2,516 49	1,270 85	259 30	889 22	–	97 12	11
–	–	141 75	15	1,090 63	637 55	80 38	351 70	–	21 00	12
3,828 25	348 50	548 50	1,536 02	6,244 07	643 10	371 74	682 45	450 00	4,096 78	13
5,171 40	2,017 00	3,185 09	1,671 00	13,153 02	5,430 75	508 10	6,139 17	75 00	[2] 1,000 00	14
200 90	–	–	[3] 206 00	1,294 53	939 50	–	355 03	–	–	15
[5] 6,107 45	–	751 75	4,459 21	9,258 96	[4] 1,018 65	1,493 35	2,117 48	–	4,629 48	16
235 94	–	112 00	150 92	1,337 34	833 89	6 40	[6] 250 00	–	247 05	17
3,099 62	–	4,746 19	578 94	23,795 29	5,210 00	618 74	17,966 55	–	–	18
–	–	–	–	–	–	–	–	–	–	19
–	–	–	–	1,207 30	812 25	–	150 00	1 50	213 55	20
2,600 30	113 05	439 75	1,292 76	6,211 60	2,142 05	817 97	906 41	334 00	2,011 17	21
772 35	51 75	63 50	89 45	2,032 15	798 50	340 16	353 99	3 00	536 50	22
1,689 45	370 00	373 50	548 57	4,388 13	1,047 40	41 93	1,321 02	145 08	1,832 70	23
–	–	–	50 00	567 43	484 05	–	83 38	–	–	24
2,516 75	407 10	348 93	69 80	3,937 16	844 20	338 35	–	–	2,751 61	25
1,158 75	67 25	334 75	458 78	3,362 46	1,644 26	345 67	243 50	101 00	1,028 03	26
665 55	49 50	133 75	927 37	2,651 97	1,237 49	222 70	850 78	55 00	289 00	27
2,311 75	194 35	536 25	213 05	3,696 36	610 65	58 10	2,572 11	175 00	280 50	28
16,496 50	3,641 00	4,042 46	6,572 83	39,020 50	9,643 20	5,287 71	23,178 84	16 67	894 08	29
5,035 35	1,416 45	843 25	1,113 32	10,318 55	2,763 75	526 98	7,027 82	–	–	30
3,968 21	248 00	521 75	1,695 24	4,733 94	1,075 72	–	361 29	–	3,296 93	31
2,824 00	437 50	530 00	3,215 52	8,394 33	1,719 25	1,160 79	5,331 29	183 00	–	32
4,623 00	1,273 50	1,051 95	429 64	11,074 93	2,760 01	801 85	7,432 40	–	80 67	33
2,765 00	337 80	496 09	204 29	4,808 35	1,811 85	400 88	4,901 11	[10] 694 51	–	34
$96,777 58	$17,641 26	$26,851 48	$30,625 10	$225,444 12	$59,682 60	$19,755 66	$107,250 99	$4,285 91	$34,468 96	

[7] Represented on the Board by special enactment and makes no returns.

[8] Includes cash on hand, last report.

[9] Racing department.

[10] And notes.

Analysis of General Premiums and Gratuities offered, ending Dec. 31, 1912;

	Societies.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$1,850 90	$913 05	$873 90
2	Barnstable County,	2,259 25	1,209 00	926 70
3	Blackstone Valley,	1,588 20	733 60	733 60
4	Deerfield Valley,	1,318 25	941 75	920 60
5	Eastern Hampden,	1,150 25	1,105 93	1,096 93
6	Essex,	1,959 75	1,157 25	966 75
7	Franklin County,	1,799 00	1,274 80	1,275 90
8	Hampshire,	1,772 95	869 05	855 30
9	Hampshire, Franklin and Hampden,	2,283 00	1,688 00	1,688 00
10	Highland,	1,084 70	778 85	778 85
11	Hillside,	1,494 00	1,098 00	1,098 00
12	Hingham (Agricultural and Horticultural),	1,176 50	593 80	565 10
13	Hoosac Valley,	2,318 75	563 85	518 60
14	Housatonic,	3,083 25	2,257 75	2,094 25
15	Lenox Horticultural,	1,169 75	855 00	855 00
16	Marshfield (Agricultural and Horticultural),	1,425 65	967 65	954 35
17	Martha's Vineyard,	795 75	807 54	806 54
18	Massachusetts Horticultural,	7,194 42	5,008 75	4,878 50
19	Massachusetts Society for Promoting Agriculture,[2]	–	–	–
20	Middlesex North,	903 30	768 50	716 75
21	Middlesex South,	[3] –	[3] –	[3] –
22	Nantucket,	1,268 75	778 50	778 50
23	Oxford,	1,553 00	989 90	989 90
24	Plymouth County,	573 25	484 05	484 05
25	Quannapowitt,	875 45	869 20	868 20
26	Spencer (Farmers' and Mechanics' Association),	1,117 25	699 50	687 01
27	Union (Agricultural and Horticultural),	1,389 60	815 78	786 33
28	Weymouth (Agricultural and Industrial),	1,120 25	582 25	582 25
29	Worcester,	8,696 00	6,203 45	5,284 70
30	Worcester East,	3,805 60	2,636 00	2,627 00
31	Worcester North (Agricultural and Driving Association),	1,091 25	1,015 72	848 72
32	Worcester Northwest (Agricultural and Mechanical Association),	–	1,651 00	1,623 25
33	Worcester South,	3,338 00	1,373 00	1,343 00
34	Worcester County West,	1,613 35	1,039 85	1,021 85
		$63,069 37	$42,730 32	$40,528 38

[1] Orchards, nurseries, estates and gardens.

[2] Represented on the Board by special enactment, and makes no returns.

AWARDED AND PAID, AND INSTITUTES HELD, IN THE YEAR ALSO MEMBERSHIP.

Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.	Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	
–	–	–	$1,211 00	$379 00	$379 00	–	–	–	1
$158 00	$26 00	$21 00	970 00	468 75	302 75	$149 00	$10 00	$10 00	2
74 00	74 00	74 00	1,207 50	502 00	502 00	–	–	–	3
–	–	–	1,001 00	732 75	732 75	–	–	–	4
180 00	99 00	99 00	615 00	545 00	515 00	–	–	–	5
142 00	33 00	33 00	895 00	436 50	361 50	173 00	10 00	10 00	6
–	–	–	1,285 00	832 90	834 00	–	–	–	7
36 00	15 00	15 00	1,266 65	474 25	461 75	–	–	–	8
–	–	–	1,783 50	1,360 00	1,360 00	–	–	–	9
–	–	–	718 50	562 50	562 50	28 00	15 50	15 50	10
90 00	85 00	85 00	927 00	613 25	613 25	75 00	70 00	70 00	11
95 75	32 00	31 00	–	–	–	138 00	20 00	20 00	12
–	–	–	1,740 00	258 00	258 00	–	–	–	13
–	–	–	1,446 00	990 75	990 75	272 00	268 00	268 00	14
50 00	–	–	–	–	–	–	–	–	15
160 00	–	–	582 50	464 10	464 10	85 50	–	–	16
78 25	51 00	51 00	447 00	401 75	401 75	–	–	–	17
[1] 226 67	[1] 45 75	[1] 45 75	–	–	–	–	–	–	18
–	–	–	–	–	–	–	–	–	19
–	–	–	389 00	270 50	237 00	–	–	–	20
[3] –	[3] –	[3] –	[3] –	[3] –	[3] –	[3] –	[3] –	[3] –	21
103 00	15 00	15 00	622 75	496 25	496 25	102 00	–	–	22
78 00	46 00	46 00	1,078 50	689 50	689 50	–	–	–	23
–	–	–	168 00	167 00	167 00	[4] 10 00	[4] 10 00	[4] 10 00	24
25 00	25 00	25 00	[5] –	[5] –	[5] –	–	–	–	25
131 00	37 00	37 00	665 00	449 75	449 75	–	–	–	26
–	–	–	964 00	513 50	493 00	–	–	–	27
–	–	–	679 00	315 40	315 40	–	–	–	28
–	–	–	7,785 25	5,473 20	5,473 20	–	–	–	29
51 00	46 00	46 00	2,326 00	1,518 25	1,518 25	55 00	40 00	40 00	30
20 00	20 00	20 00	[6] 752 00	[6] 745 00	[6] 745 00	–	–	–	31
–	–	–	–	918 00	912 25	–	–	–	32
249 00	164 00	164 00	1,572 50	846 50	846 50	–	–	–	33
103 00	78 00	78 00	1,168 50	723 75	705 75	–	–	–	34
$2,030 72	$891 75	$885 75	$34,276 15	$22,151 10	$21,820 95	$1,087 50	$443 50	$443 50	

[3] Not reported. [4] Home gardens. [5] Cups and ribbons. [6] Includes gratuity of $256.

Analysis of General Premiums and Gratuities offered, ending Dec. 31, 1912;

	Societies.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	Amount paid under Head of Dairy Products.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$282 55	$214 50	$214 50	$3 25	$1 50	$1 50
2	Barnstable County,	487 75	381 05	317 25	12 00	5 00	5 00
3	Blackstone Valley,	114 00	77 45	77 45	10 00	5 00	5 00
4	Deerfield Valley,	73 50	68 00	68 00	12 00	6 00	6 00
5	Eastern Hampden,	185 25	201 00	201 00	32 00	25 00	25 00
6	Essex,	436 00	340 75	229 50	14 00	4 00	4 00
7	Franklin County,	308 75	266 45	266 45	22 00	10 00	10 00
8	Hampshire,	221 25	161 50	160 25	6 00	4 50	4 50
9	Hampshire, Franklin and Hampden,	214 75	193 00	193 00	36 00	5 00	5 00
10	Highland,	78 70	50 40	50 40	5 00	4 00	4 00
11	Hillside,	130 00	98 65	98 65	4 00	2 00	2 00
12	Hingham (Agricultural and Horticultural),	711 75	348 70	325 65	3 50	2 00	2 00
13	Hoosac Valley,	137 50	92 75	92 75	18 00	4 00	4 00
14	Housatonic,	372 75	307 00	307 00	38 00	38 00	38 00
15	Lenox Horticultural,	1,097 00	850 50	850 50	–	–	–
16	Marshfield (Agricultural and Horticultural),	247 90	198 90	186 35	12 50	6 50	6 50
17	Martha's Vineyard,	107 25	141 01	141 01	10 00	9 00	9 00
18	Massachusetts Horticultural,	6,937 75	4,963 00	4,944 25	–	–	–
19	Massachusetts Society for Promoting Agriculture,[2]	–	–	–	–	–	–
20	Middlesex North,	274 80	188 00	172 50	–	50	50
21	Middlesex South,	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –
22	Nantucket,	211 00	70 25	70 25	16 00	–	–
23	Oxford,	125 75	97 25	97 25	12 00	6 00	6 00
24	Plymouth County,	205 75	158 70	158 70	–	25	25
25	Quannapowitt,	125 00	126 75	126 75	–	–	–
26	Spencer (Farmers' and Mechanics' Association),	179 00	109 00	109 00	10 00	10 00	10 00
27	Union (Agricultural and Horticultural),	157 00	105 11	102 40	13 25	8 75	8 75
28	Weymouth (Agricultural and Industrial),	210 00	105 70	105 70	5 50	–	–
29	Worcester,	513 00	461 50	461 50	22 00	10 00	10 00
30	Worcester East,	686 75	586 90	586 90	16 00	–	–
31	Worcester North (Agricultural and Driving Association),	183 25	152 25	152 25	–	–	–
32	Worcester Northwest (Agricultural and Mechanical Association),	[4] –	386 75	374 75	[4] –	5 00	5 00
33	Worcester South,	216 75	187 25	187 25	23 00	15 00	15 00
34	Worcester County West,	166 00	127 00	127 00	14 00	5 00	5 00
		$15,488 45	$11,823 05	$11,562 19	$370 00	$192 00	$192 00

[1] Does not include amount offered children for cooking, sewing, household art and decorating, and some school shop work, this amount not being reported.

[2] Represented on the Board by special enactment, and makes no returns.

AWARDED AND PAID, AND INSTITUTES HELD, IN THE YEAR ALSO MEMBERSHIP — *Continued.*

Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount offered under Head of Agricultural Implements.	Amount awarded under Head of Agricultural Implements.	Amount paid under Head of Agricultural Implements.	Amount offered under Head of Grange Exhibits.	Amount awarded under Head of Grange Exhibits.	Amount paid under Head of Grange Exhibits.	
$189 10	$162 80	$162 80	–	–	–	$90 00	$90 00	$90 00	1
417 50	318 20	270 70	$25 00	–	–	40 00	–	–	2
180 70	75 15	75 15	–	–	–	–	–	–	3
108 75	86 25	86 25	–	–	–	–	–	–	4
93 00	72 65	72 65	–	–	–	45 00	20 00	20 00	5
[1] 71 75	125 00	120 75	28 00	$8 00	$8 00	175 00	175 00	175 00	6
98 25	105 45	105 45	–	–	–	50 00	25 00	25 00	7
93 05	63 80	63 80	–	–	–	–	–	–	8
223 75	105 00	105 00	–	–	–	25 00	25 00	25 00	9
254 50	146 45	146 45	–	–	–	–	–	–	10
243 00	229 10	229 10	–	–	–	25 00	–	–	11
227 50	191 10	186 45	–	–	–	–	–	–	12
417 25	209 10	209 10	6 00	–	–	–	–	–	13
690 50	501 25	501 25	–	–	–	75 00	25 00	25 00	14
22 75	4 50	4 50	–	–	–	–	–	–	15
312 25	273 15	272 40	–	–	–	–	–	–	16
153 25	201 75	200 75	–	–	–	–	–	–	17
–	–	–	–	–	–	–	–	–	18
–	–	–	–	–	–	–	–	–	19
[3] 59 50	139 50	136 75	–	–	–	100 00	90 00	90 00	20
[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	21
214 50	197 00	197 00	–	–	–	–	–	–	22
116 75	93 15	93 15	–	–	–	50 00	–	–	23
139 50	108 10	108 10	–	–	–	50 00	40 00	40 00	24
75 00	67 00	67 00	–	–	–	275 00	275 00	275 00	25
104 25	83 75	71 26	25 00	10 00	10 00	–	–	–	26
195 35	129 92	124 44	–	–	–	–	–	–	27
225 75	161 15	161 15	–	–	–	–	–	–	28
95 75	80 75	80 75	–	–	–	250 00	175 00	175 00	29
410 85	236 00	236 00	10 00	8 00	8 00	–	–	–	30
76 00	73 47	73 47	–	–	–	60 00	25 00	25 00	31
[4] –	106 25	96 25	–	–	–	[4] –	235 00	235 00	32
181 75	130 25	130 25	–	–	–	65 00	30 00	–	33
141 85	103 10	103 10	10 00	3 00	3 00	5 00	–	–	34
$5,833 65	$4,580 09	$4,491 22	$104 00	$29 00	$29 00	$1,380 00	$1,230 00	$1,200 00	

[3] Does not include amount offered children for pressed leaves and flowers, needle and fancy work, bread, cake, general cooking, wood marking and carving, this amount not being reported.

[4] Not reported.

ANALYSIS OF GENERAL PREMIUMS AND GRATUITIES OFFERED, ENDING DEC. 31, 1912;

	SOCIETIES.	Amount offered for All Other Objects, Strictly Agricultural.	Amount awarded for All Other Objects, Strictly Agricultural.	Amount paid for All Other Objects, Strictly Agricultural.	Amount paid for Trotting.	Amount paid for Sports and Games.	Other Attractions.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$75 00	$65 25	$65 25	–	–	$511 18
2	Barnstable County,	–	–	–	$1,661 00	$833 00	1,225 00
3	Blackstone Valley,	–	–	–	325 00	200 00	75 00
4	Deerfield Valley,	124 00	48 75	48 75	465 00	6 00	–
5	Eastern Hampden,	–	140 28	131 28	1,570 00	64 75	775 00
6	Essex,	25 00	25 00	25 00	–	50 00	34 58
7	Franklin County,	35 00	35 00	35 00	1,150 00	425 00	–
8	Hampshire,	150 00	150 00	150 00	610 00	123 00	177 00
9	Hampshire, Franklin and Hampden,	–	–	–	1,252 50	23 80	1,975 30
10	Highland,	–	–	–	75 00	–	–
11	Hillside,	–	–	–	62 00	5 00	–
12	Hingham (Agricultural and Horticultural),	–	–	–	–	–	–
13	Hoosac Valley,	–	–	–	1,520 00	363 00	1,000 00
14	Housatonic,	189 00	127 75	127 75	3,060 00	–	750 00
15	Lenox Horticultural,	–	–	–	–	–	–
16	Marshfield (Agricultural and Horticultural),	25 00	25 00	25 00	1,800 00	–	814 00
17	Martha's Vineyard,	–	–	–	–	77 35	170 00
18	Massachusetts Horticultural,	–	–	–	–	–	–
19	Massachusetts Society for Promoting Agriculture,[3]	–	–	–	–	–	–
20	Middlesex North,	80 00	80 00	80 00	–	–	–
21	Middlesex South,	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –
22	Nantucket,	–	–	–	300 00	50 00	–
23	Oxford,	92 00	58 00	58 00	1,215 00	–	472 00
24	Plymouth County,	–	–	–	–	–	–
25	Quannapowitt,	–	–	–	686 00	120 00	578 35
26	Spencer (Farmers' and Mechanics' Association),	–	–	–	900 00	50 00	75 00
27	Union (Agricultural and Horticultural),	60 00	58 50	58 50	390 00	26 00	–
28	Weymouth (Agricultural and Industrial),	–	–	–	800 00	217 50	587 85
29	Worcester,	–	–	–	3,450 00	702 10	4,306 43
30	Worcester East,	250 00	200 85	200 85	713 85	–	1,693 00
31	Worcester North (Agricultural and Driving Association),	–	–	–	1,750 00	92 00	1,079 70
32	Worcester Northwest (Agricultural and Mechanical Association),	–	–	–	1,110 00	40 00	1,272 41
33	Worcester South,	–	–	–	1,535 00	100 93	1,403 97
34	Worcester County West,	–	–	–	707 75	20 00	100 00
		$1,105 00	$1,014 38	$1,005 38	$27,138 10	$3,630 93	$19,075 77

[1] And gratuities. [2] Estimated.

AWARDED AND PAID, AND INSTITUTES HELD, IN THE YEAR ALSO MEMBERSHIP — *Concluded.*

Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institute Sessions held.	Average Attendance per Session.	
[1] 314	–	14	$39 15	201	33	234	6	58	1
207	241	15	–	205	175	380	4	95	2
89	10	9	–	273	232	505	3	81	3
[2] 175	–	21	96 15	965	262	1,227	8	195	4
130	–	22	–	274	171	445	2	77	5
144	50	19	–	738	17	755	5	107	6
[2] 500	[2] 125	15	–	1,400	100	1,500	5	100	7
144	3	10	–	435	185	620	3	96	8
302	–	29	–	685	265	950	3	116	9
197	–	17	–	241	128	369	4	54	10
350	2	16	–	917	51	968	7	125	11
129	227	4	–	341	134	475	3	144	12
152	5	6	45 25	376	15	391	2	38	13
504	23	15	163 50	1,810	81	1,891	2	135	14
25	–	4	–	126	18	144	4	103	15
127	210	32	–	503	293	796	6	57	16
400	20	6	–	73	71	144	3	35	17
133	86	75	111 50	716	123	839	10	207	18
–	–	–	–	–	–	–	–	–	19
136	40	9	–	483	258	741	12	179	20
[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	[4] –	5	209	21
141	74	1	–	216	324	540	2	185	22
134	13	16	–	343	277	620	3	142	23
220	33	11	–	610	512	1,122	6	61	24
223	–	25	1 00	10	–	10	–	–	25
144	11	18	127 50	416	413	829	3	108	26
156	59	21	76	679	861	1,540	3	215	27
–	–	12	–	480	10	490	3	97	28
211	16	47	918 75	1,570	247	1,817	5	93	29
345	120	42	9 00	125	113	238	5	125	30
389	16	10	167 00	62	–	62	8	140	31
170	–	27	–	470	240	710	5	102	32
112	63	20	277 50	527	772	1,299	5	52	33
170	42	26	20 00	386	76	462	6	41	34
6,573	1,489	614	$1,977 06	16,656	6,457	23,113	151	3,572	

[3] Represented on the Board by special enactment, and makes no returns. [4] Not reported.

ANALYSIS OF PREMIUMS AND GRATUITIES OFFERED, AWARDED AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums.	Total Amount paid in Premiums.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$174 00	$46 45	$46 45
2	Barnstable County,	89 50	34 60	34 60
3	Blackstone Valley,	95 00	67 25	67 25
4	Deerfield Valley,	80 50	48 05	48 05
5	Eastern Hampden,	146 75	75 50	75 50
6	Essex,	95 25	68 25	64 25
7	Franklin County,	75 50	22 75	22 75
8	Hampshire,	273 50	199 00	199 00
9	Hampshire, Franklin and Hampden,	282 30	114 00	114 00
10	Highland,	80 00	49 10	49 10
11	Hillside,	140 00	105 85	105 85
12	Hingham (Agricultural and Horticultural),	138 00	43 75	43 20
13	Hoosac Valley,	88 00	52 25	52 25
14	Housatonic,	202 00	113 00	113 00
15	Lenox Horticultural,	159 00	84 50	84 50
16	Marshfield (Agricultural and Horticultural),	90 00	64 30	64 30
17	Martha's Vineyard,	–	–	–
18	Massachusetts Horticultural,	200 00	220 00	220 00
19	Massachusetts Society for Promoting Agriculture,[1]	–	–	–
20	Middlesex North,	[2] –	104 50	104 50
21	Middlesex South,	[2] –	[2] –	[2] –
22	Nantucket,	469 00	20 00	20 00
23	Oxford,	213 75	57 50	57 50
24	Plymouth County,	–	–	–
25	Quannapowitt,	–	–	–
26	Spencer (Farmers' and Mechanics' Association),	133 75	57 25	57 25
27	Union (Agricultural and Horticultural),	162 50	60 40	60 40
28	Weymouth (Agricultural and Industrial),	75 75	28 30	28 30
29	Worcester,	147 00	92 50	92 50
30	Worcester East,	190 50	137 75	137 75
31	Worcester North (Agricultural and Driving Association),	56 25	42 25	42 25
32	Worcester Northwest (Agricultural and Mechanical Association),	[2] –	69 25	68 00
33	Worcester South,	90 00	64 25	62 75
34	Worcester County West,	188 50	82 25	82 25
		$4,136 30	$2,224 80	$2,217 50

[1] Represented on the Board by special enactment, and makes no returns. [2] Not reported.

PAID TO CHILDREN AND YOUTHS IN THE YEAR ENDING DEC. 31, 1912.

Amount offered under Head of Animals.	Amount awarded under Head of Animals.	Amount paid under Head of Animals.	Amount offered under Head of Farm Crops (Crops in Field).	Amount awarded under Head of Farm Crops (Crops in Field).	Amount paid under Head of Farm Crops (Crops in Field).	Amount offered under Head of Farm Crops (Exhibits in Hall).	Amount awarded under Head of Farm Crops (Exhibits in Hall).	Amount paid under Head of Farm Crops (Exhibits in Hall).	
$20 25	$20 25	$20 25	$23 00	$10 00	$10 00	$13 25	$10 45	$10 45	1
34 50	10 50	10 50	–	–	–	20 50	15 60	15 60	2
28 00	28 00	28 00	8 00	8 00	8 00	17 25	10 50	10 50	3
30 00	16 00	16 00	–	–	–	20 25	15 00	15 00	4
64 25	12 25	12 25	–	–	–	11 50	2 00	2 00	5
27 25	22 00	22 00	–	–	–	31 00	21 25	21 25	6
–	–	–	–	–	–	38 75	–	–	7
33 00	11 25	11 25	60 00	60 00	60 00	33 75	14 25	14 25	8
64 25	34 25	34 25	–	–	–	25 05	12 50	12 50	9
29 00	20 25	20 25	–	–	–	21 00	7 35	7 35	10
55 00	52 00	52 00	–	–	–	5 00	1 85	1 85	11
–	–	–	89 50	8 00	8 00	25 50	17 25	17 25	12
30 25	2 50	2 50	–	–	–	18 75	11 00	11 00	13
52 00	28 00	28 00	21 00	6 00	6 00	–	–	–	14
–	–	–	–	–	–	12 25	1 00	1 00	15
25 00	25 20	25 20	–	–	–	30 00	8 10	8 10	16
–	–	–	–	–	–	–	–	–	17
–	–	–	–	–	–	110 00	112 00	112 00	18
–	–	–	–	–	–	–	–	–	19
–	19 75	19 75	–	–	–	[2] –	29 25	29 25	20
[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	21
149 75	–	–	58 00	–	–	72 25	10 75	10 75	22
109 50	2 00	2 00	–	–	–	35 25	4 75	4 75	23
–	–	–	–	–	–	–	–	–	24
–	–	–	–	–	–	–	–	–	25
63 00	16 00	16 00	–	–	–	21 00	11 00	11 00	26
73 50	25 75	25 75	–	–	–	39 25	8 15	8 15	27
32 25	6 75	6 75	–	–	–	9 50	–	–	28
26 00	18 75	18 75	–	–	–	–	–	–	29
48 25	32 25	32 25	–	–	–	18 75	15 25	15 25	30
6 75	3 50	3 50	–	–	–	12 75	[3] –	[3] –	31
[2] –	49 50	49 50	–	–	–	[2] –	4 25	4 00	32
20 25	25 00	25 00	–	–	–	–	–	–	33
58 50	20 00	20 00	–	–	–	64 25	26 50	26 50	34
$1,080 50	$501 70	$501 70	$259 50	$92 00	$92 00	$706 80	$370 00	$369 75	

[3] The amounts awarded and paid for farm crops in hall and for vegetables in field and hall each aggregate $38.75.

Analysis of Premiums and Gratuities offered, awarded and paid

	SOCIETIES.	Amount offered under Head of Fruit.	Amount awarded under Head of Fruit.	Amount paid under Head of Fruit.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$9 00	$1 75	$1 75
2	Barnstable County,	–	–	–
3	Blackstone Valley,	2 25	–	–
4	Deerfield Valley,	25	25	. 25
5	Eastern Hampden,	51 00	41 25	41 25
6	Essex,	6 50	2 50	–
7	Franklin County,	–	–	–
8	Hampshire,	6 00	–	–
9	Hampshire, Franklin and Hampden,	10 00	2 00	2 00
10	Highland,	12 00	6 00	6 00
11	Hillside,	–	–	–
12	Hingham (Agricultural and Horticultural),	–	–	–
13	Hoosac Valley,	9 00	–	–
14	Housatonic,	–	–	–
15	Lenox Horticultural,	–	–	–
16	Marshfield (Agricultural and Horticultural),	–	–	–
17	Martha's Vineyard,	–	–	–
18	Massachusetts Horticultural,	–	–	–
19	Massachusetts Society for Promoting Agriculture,[1]	–	–	–
20	Middlesex North,	–	–	–
21	Middlesex South,	[2] –	[2] –	[2] –
22	Nantucket,	83 25	25	25
23	Oxford,	–	–	–
24	Plymouth County,	–	–	–
25	Quannapowitt,	–	–	–
26	Spencer (Farmers' and Mechanics' Association),	–	–	–
27	Union (Agricultural and Horticultural),	10 00	6 25	6 25
28	Weymouth (Agricultural and Industrial),	–	–	–
29	Worcester,	–	–	–
30	Worcester East,	10 00	3 00	3 00
31	Worcester North (Agricultural and Driving Association),	–	–	–
32	Worcester Northwest (Agricultural and Mechanical Association),	[2] –	1 00	1 00
33	Worcester South,	10 00	1 50	–
34	Worcester County West,	9 25	–	–
		$228 50	$65 75	$61 75

[1] Represented on the Board by special agreement, and makes no returns. [2] Not reported.

TO CHILDREN AND YOUTHS IN THE YEAR ENDING DEC. 31, 1912 — *Concluded.*

Amount offered under Head of Vegetables (Crops in Field).	Amount awarded under Head of Vegetables (Crops in Field).	Amount paid under Head of Vegetables (Crops in Field).	Amount offered under Head of Vegetables (Exhibits in Hall).	Amount awarded under Head of Vegetables (Exhibits in Hall).	Amount paid under Head of Vegetables (Exhibits in Hall).	Amount offered under Head of Stock Judging.	Amount awarded under Head of Stock Judging.	Amount paid under Head of Stock Judging.	
$38 00	–	–	$40 50	$4 00	$4 00	$30 00	–	–	1
–	–	–	34 50	8 50	8 50	–	–	–	2
8 00	$8 00	$8 00	31 50	12 75	12 75	–	–	–	3
–	–	–	30 00	16 80	16 80	–	–	–	4
–	–	–	–	–	–	20 00	$20 00	$20 00	5
3 50	1 50	1 50	27 00	21 00	19 50	–	–	–	6
–	–	–	36 75	22 75	22 75	–	–	–	7
73 00	73 00	73 00	37 75	10 50	10 50	30 00	30 00	30 00	8
–	–	–	63 00	35 25	35 25	120 00	30 00	30 00	9
–	–	–	18 00	15 50	15 50	–	–	–	10
25 00	–	–	25 00	25 00	25 00	30 00	27 00	30 00	11
9 50	9 50	9 50	13 50	9 00	8 45	–	–	–	12
–	–	–	30 00	38 75	38 75	–	–	–	13
63 00	17 00	17 00	27 00	23 00	23 00	39 00	39 00	39 00	14
107 50	73 50	73 50	39 25	10 00	10 00	–	–	–	15
–	–	–	35 00	31 00	31 00	–	–	–	16
–	–	–	–	–	–	–	–	–	17
–	–	–	90 00	108 00	108 00	–	–	–	18
–	–	–	–	–	–	–	–	–	19
–	–	–	[2] –	55 50	55 50	–	–	–	20
[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	[2] –	21
26 00	–	–	79 75	9 00	9 00	–	–	–	22
–	–	–	39 00	20 75	20 75	30 00	30 00	30 00	23
–	–	–	–	–	–	–	–	–	24
–	–	–	–	–	–	–	–	–	25
–	–	–	49 75	30 25	30 25	–	–	–	26
–	–	–	39 75	20 25	20 25	–	–	–	27
–	–	–	34 00	21 55	21 55	–	–	–	28
–	–	–	91 00	43 75	43 75	30 00	30 00	30 00	29
–	–	–	74 50	48 25	48 25	39 00	39 00	39 00	30
24 00	[3] –	[3] –	12 75	[3] –	[3] –	–	–	–	31
–	–	–	[2] –	14 50	13 50	–	–	–	32
–	–	–	29 75	13 00	13 00	30 00	24 75	24 75	33
–	–	–	46 50	27 75	27 75	10 00	8 00	8 00	34
$377 50	$182 50	$182 50	$1,075 50	$696 35	$693 30	$408 00	$277 75	$280 75	

[3] The amounts awarded and paid for farm crops in hall and for vegetables in field and hall each aggregate $38.75.

DIRECTORY

OF THE

Agricultural and Similar Organizations of Massachusetts.

1913.

State Board of Agriculture, 1913.

Members ex Officio.

His Excellency EUGENE N. FOSS.
His Honor DAVID I. WALSH.
Hon. FRANK J. DONAHUE, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, LL.D., *President Massachusetts Agricultural College.*
FREDERICK F. WALKER, *Commissioner of Animal Industry.*
F. WM. RANE, B. Agr., M.S., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board to July 1.*
WILFRID WHEELER, *Secretary of the Board after July 1.*

Members appointed by the Governor and Council.

	Term expires
FRANK P. NEWKIRK of Easthampton,	1914
HENRY M. HOWARD of West Newton,	1915
CHARLES M. GARDNER of Westfield,	1916

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agricultural and Horticultural),	A. WILLIS BARTLETT of Salisbury,	1915
Barnstable County,	JOHN BURSLEY of West Barnstable,	1916
Blackstone Valley,	JACOB A. WILLIAMS of Northbridge,	1915
Deerfield Valley,	ERNEST W. PAYNE of Heath,	1914
Eastern Hampden,	O. E. BRADWAY of Monson,	1915
Essex,	FREDERICK A. RUSSELL of Methuen,	1914
Franklin County,	GEO. E. TAYLOR, Jr., of Shelburne,	1916
Hampshire,	F. E. FARRAR of Amherst,	1916
Hampshire, Franklin and Hampden,	RUFUS M. SMITH of Hadley,	1915
Highland,	JOHN T. BRYAN of Middlefield (P. O. Chester, R. F. D.),	1914
Hillside,	HARRY A. FORD of Windsor,	1914
Hingham (Agricultural and Horticultural),	U. S. BATES of Hingham,	1915
Hoosac Valley,	ABNER TOWNE of Williamstown,	1915
Housatonic,	R. H. RACE of North Egremont,	1915
Lenox Horticultural,	ALFRED H. WINGETT of Lenox,	1914
Marshfield (Agricultural and Hort'l),	WALTER H. FAUNCE of Kingston,	1915
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1916
Massachusetts Horticultural,	WILFRID WHEELER of Concord,	1915
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1915
Middlesex North,	GEO. W. TRULL of Tewksbury (P. O. Lowell, R. F. D.),	1914
Middlesex South,	JOHN J. ERWIN of Wayland,	1914
Nantucket,	HERBERT G. WORTH of Nantucket,	1915
Oxford,	WALTER A. LOVETT of Oxford,	1916
Plymouth County,	AUGUSTUS PRATT of Middleborough (P. O. North Middleborough),	1914
Quannapowitt,	CALVERT H. PLAYDON, D.V.S., of Reading,	1916
Spencer (Farmers' and Mechs.' Ass'n),	EDWARD WARREN of Leicester,	1916
Union (Agricultural and Hort'l),	HENRY K. HERRICK of Blandford,	1916
Weymouth (Agricultural and Ind'l),	THERON L. TIRRELL of Weymouth (P. O. South Weymouth),	1915
Worcester,	B. W. POTTER of Worcester,	1914
Worcester East,	GEO. F. MORSE of Lancaster,	1915
Worcester North (Agricultural and Driving Association),	L. E. FLETCHER of Fitchburg,	1915
Worcester Northwest (Agricultural and Mechanical),	ALBERT ELLSWORTH of Athol,	1913
Worcester South,	WILLIAM E. PATRICK of Warren,	1913
Worcester County West,	JOHN L. SMITH of Barre,	1914

ORGANIZATION OF THE BOARD.

OFFICERS.

President, ... His Excellency EUGENE N. FOSS, *ex officio*.
1st Vice-President, . . JOHN BURSLEY of West Barnstable.
2d Vice-President, . . FREDERICK A. RUSSELL of Methuen.
Secretary, ... J. LEWIS ELLSWORTH of Worcester, to July 1. WILFRID WHEELER of Concord, after July 1.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. John Bursley of West Barnstable.
O. E. Bradway of Monson.
Geo. F. Morse of Lancaster.
William E. Patrick of Warren.
Charles M. Gardner of Westfield.
Frederick A. Russell of Methuen.
John L. Smith of Barre.
Henry M. Howard of West Newton.
Walter A. Lovett of Oxford.

Committee on Agricultural Societies.

Messrs. O. E. Bradway of Monson.
Albert Ellsworth of Athol.
T. L. Tirrell of South Weymouth.
Jacob A. Williams of Northbridge.
Ernest W. Payne of Heath.

Committee on Domestic Animals, Poultry and Dairy Products.

Messrs. William E. Patrick of Warren.
Herbert G. Worth of Nantucket.
Abner Towne of Williamstown.
Rufus M. Smith of Hadley.
Henry K. Herrick of Blandford.

Committee on the Massachusetts Agricultural College and the Massachusetts Agricultural Experiment Station.

Messrs. John Bursley of West Barnstable.
Frank P. Newkirk of Easthampton.
Wm. E. Patrick of Warren.
John J. Erwin of Wayland.
R. Henry Race of North Egremont.

Committee on Orcharding and Fruit Growing.

Messrs. Frederick A. Russell of Methuen.
Alfred H. Wingett of Lenox.
Ernest W. Payne of Heath.
R. H. Race of North Egremont.
Edward Warren of Leicester.

Committee on Grasses and Forage Crops.

Messrs. John L. Smith of Barre.
Harry A. Ford of Windsor.
U. S. Bates of Hingham.
N. I. Bowditch of Framingham.
Calvert H. Playdon of Reading.

Committee on Markets and Transportation.

Messrs. Charles M. Gardner of Westfield.
George W. Trull of Tewksbury.
Burton W. Potter of Worcester.
F. E. Farrar of Amherst.
L. E. Fletcher of Fitchburg.
A. Willis Bartlett of Salisbury.

Committee on Farm Tools and Machinery.

Messrs. Walter A. Lovett of Oxford.
Jacob A. Williams of Northbridge.
Frank P. Newkirk of Easthampton.
James F. Adams of West Tisbury.
A. Willis Bartlett of Salisbury.

Committee on Institutes and Public Meetings.

Messrs. George F. Morse of Lancaster.
James F. Adams of West Tisbury.
Kenyon L. Butterfield of Amherst.
George W. Trull of Tewksbury.
Geo. E. Taylor, Jr., of Shelburne.

Committee on Irrigation and Drainage.

Messrs. Henry M. Howard of West Newton.
John T. Bryan of Middlefield.
John J. Erwin of Wayland.
F. E. Farrar of Amherst.
Walter H. Faunce of Kingston.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. George W. Trull of Tewksbury, 1913; Charles M. Gardner of Westfield, 1914; O. E. Bradway of Monson, 1915.

Executive Officer,	J. L. Ellsworth, to July 1. Wilfrid Wheeler, after July 1.
General Agent,	P. M. Harwood of Barre.

Office, Room 136, State House.

STATE NURSERY INSPECTOR.

Henry T. Fernald, Ph.D., of Amherst.

STATE ORNITHOLOGIST.

Edward Howe Forbush of Westborough.

STATE INSPECTOR OF APIARIES.

Burton N. Gates, Ph.D., of Amherst.

SPECIALISTS.

Chemist,	Dr. J. B. Lindsey,	Amherst.
Entomologist,	Prof. C. H. Fernald,	Amherst.
Botanist,	Dr. Geo. E. Stone,	Amherst.
Pomologist,	Prof. F. C. Sears,	Amherst.
Veterinarian,	Prof. James B. Paige,	Amherst.
Engineer,	Wm. Wheeler,	Concord.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

Board of Trustees.	Term expires
Chas. E. Ward of Buckland,	1914
Elmer D. Howe of Marlborough,	1914
Nathaniel I. Bowditch of Framingham,	1915
William Wheeler of Concord,	1915
Arthur G. Pollard of Lowell,	1916
Charles A. Gleason of New Braintree,	1916
Frank Gerrett of Greenfield,	1917
Harold L. Frost of Arlington,	1917
Frank A. Hosmer of Amherst,	1918
Charles H. Preston of Danvers,	1918
Davis R. Dewey of Cambridge,	1919
Geo. P. O'Donnell of Northampton,	1919
William H. Bowker of Concord,	1920
George H. Ellis of West Newton,	1920

Members ex Officio.

His Excellency Governor Eugene N. Foss,
President of the Corporation.

Kenyon L. Butterfield, LL.D.,	*President of the College.*
David Snedden,	*Commissioner of Education.*
J. Lewis Ellsworth, to July 1, Wilfrid Wheeler, after July 1,	*Secretary State Board of Agriculture.*

Officers elected by the Board of Trustees.

Charles A. Gleason of New Braintree,	*Vice-President of the Corporation.*
J. Lewis Ellsworth of Worcester, to July 1, Wilfrid Wheeler of Concord, after July 1,	*Secretary.*
Fred C. Kenney of Amherst,	*Treasurer.*
Charles A. Gleason of Springfield,	*Auditor.*
Kenyon L. Butterfield, LL.D., of Amherst,	*President of the College.*

Examining Committee of the Board of Agriculture.

Messrs. Bursley, Newkirk, Patrick, Erwin and Race.

Massachusetts Agricultural Experiment Station.

William P. Brooks, Ph.D.,	*Director.*
Joseph B. Lindsey, Ph.D.,	*Vice-Director.*
Frank A. Waugh, M.Sc.,	*Horticulturist.*
George E. Stone, Ph.D.,	*Botanist and Vegetable Pathologist.*
Henry T. Fernald, Ph.D.,	*Entomologist.*
James B. Paige, B.Sc., D.V.S.,	*Veterinarian.*
John E. Ostrander, A.M., C.E.,	*Meteorologist.*

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,[1]	A. Willis Bartlett, Salisbury.	M. H. Sands, Amesbury.	John J. Mason, Amesbury.
Barnstable County,	T. C. Thacher, Yarmouthport.	Marcus N. Harris, Barnstable.	Henry C. Davis, Cummaquid.
Blackstone Valley,	W. A. L. Bazeley, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.	Chas. A. Barton, Uxbridge.
Deerfield Valley,	F. M. Legate, Charlemont.	S. W. Hawkes, Charlemont.	C. T. Haskins, Charlemont.
Eastern Hampden,	Omer E. Bradway, Monson.	George E. Clough, Palmer.	Francis L. Jones, Palmer.
Essex,	Chas. H. Preston, Hathorne.	Fred A. Smith, Ipswich.	– –
Franklin County,	James Butler, Greenfield.	J. H. Murphy, Greenfield.	Frank H. Snow, Greenfield.
Hampshire,	Francis E. Farrar, Amherst.	James W. T. Davis, Amherst.	James W. T. Davis, Amherst.
Hampshire, Franklin and Hampden,	Clarence E. Hodgkins, Northampton.	Chas. A. Montgomery, Northampton.	Alvertus J. Morse, Northampton.
Highland,	Harry A. Ford, Dalton.	John T. Bryan, R. F. D., Chester.	Wesley A. Olds, Middlefield.
Hillside,	M. S. Howes, Cummington.	Clement F. Burr, Worthington.	Howard E. Drake, Cummington.
Hingham,[1]	Alfred L. Lincoln, Hingham.	William L. Howard, Hingham.	Harry F. Zahn, Hingham.
Hoosac Valley,	F. D. Stafford, North Adams.	George F. Miller, North Adams.	C. J. Arnold, North Adams.
Housatonic,	Fred DeBell, Great Barrington.	Joseph H. Maloney, Great Barrington.	George L. Taylor, Great Barrington.
Lenox Horticultural,	A. McConnachie, Lenox.	George H. Instone, Lenox.	A. J. Loveless, Lenox.
Marshfield,[1]	Thomas W. Lawson, Boston.	Israel H. Hatch, North Marshfield.	M. Herman Kent, Marshfield.
Martha's Vineyard,	Davis D. Look, West Tisbury.	F. Allen Look, West Tisbury.	George Hunt Luce, West Tisbury.
Massachusetts Horticultural,	John K. M. L. Farquhar, Boston.	William P. Rich, Chelsea.	Walter Hunnewell, Boston.
Massachusetts Society for Promoting Agriculture,	Prof. Chas. S. Sargent, Brookline.	Gen. Francis H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex North,	George W. Trull, Tewksbury.	George B. Coburn, Lowell.	John A. Weinbeck, Lowell.
Middlesex South,	John P. Bowditch, Framingham.	Peter N. Everett, Framingham.	George E. Fay, Framingham.
Nantucket,	Herbert G. Worth, Nantucket.	Josiah F. Murphy, Nantucket.	Benjamin F. Worth, Nantucket.

[1] And horticultural.

Agricultural Societies, etc. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Oxford,	Walter E. Schuster, East Douglas.	James E. Darling, Oxford.	George E. Chaffee, Oxford.
Plymouth County,	Augustus Pratt, North Middleborough.	Howard B. Wilbur, West Bridgewater.	Howard B. Wilbur, West Bridgewater.
Quannapowitt,	Arthur H. Jewett, Reading.	Arthur W. Coolidge, Reading.	Henry A. Upton, North Reading.
Spencer Farmers' and Mechanics' Association,	Harry R. Prescott, Spencer.	Geo. H. Ramer, Spencer.	Geo. H. Ramer, Spencer.
Union,[1]	Henry K. Herrick, Blandford.	Enos W. Boise, Blandford.	George O. Millard, Blandford.
Weymouth (Agricultural and Industrial),	Ralph P. Burrell, South Weymouth.	Thomas V. Nash, South Weymouth.	D. Frank Daley, South Weymouth.
Worcester,	Walter D. Ross, Worcester.	Elisha S. Knowles, Worcester.	Leander F. Herrick, Worcester.
Worcester East,	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	John W. Forrester, Clinton.
Worcester North (Agricultural and Driving Association),	L. L. Richardson, Leominster.	J. C. McMullen, Fitchburg.	F. A. Miller, Fitchburg.
Worcester Northwest (Agricultural and Mechanical),	Frederick H. Sprague, Orange.	Albert Ellsworth, Athol.	Ernest L. Worrick, Athol.
Worcester South,	Charles V. Corey, Sturbridge,	George H. Clemence, Southbridge.	Ernest G. Barnes, Sturbridge.
Worcester County West,	William A. Gaston, Boston.	Daniel H. Rice, Barre.	John S. Rice, Barre.

[1] And horticultural.

Horticultural Societies.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Hampden County,	Springfield,	Joel H. Hendrick, 632 State St., Springfield.	William F. Gale, 24 Crystal Ave., Springfield.
Houghton,	Lynn,	Frank L. Whipple, 239 Maple St., Lynn.	Miss Helen L. Newhall, 152 Alley St., Lynn.
Massachusetts,	The State,	John K. M. L. Farquhar, 6 South Market St., Boston.	William P. Rich, 300 Massachusetts Ave., Boston.
Medford,	Medford,	Charles Hayden, Medford.	Miss Kate Meldram Buss, Medford.
Melrose Horticultural and Improvement,	Melrose,	B. B. Dunbar, Melrose.	Mrs. B. B. Dunbar, Melrose.
New Bedford,	New Bedford,	Frank C. Barrows, 215 Hawthorn St., New Bedford.	J. M. Taber, 117 Sycamore St., New Bedford.
North Shore,	Manchester,	John Chapman, Pride's Crossing,	James Salter, Manchester.
Springfield Amateur,	Springfield,	J. Alden Davis, 36 Groveland St., Springfield, Mass.	Mrs. Grace Pettis Johnson, 224 State St., Springfield.
Worcester County,	Worcester,	Edward W. Breed, Clinton.	Leonard C. Midgley, Westborough.

Farmers' and Mechanics' Clubs and Associations.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Bolton,	Bolton,	Gilbert H. Wheeler, Bolton.	William M. Brigham, Bolton.
Needham,	Needham,	Richmond Favour, Natick.	Mrs. G. Howard Frost, 854 Watertown St., West Newton.
Westminster,	Westminster,	G. W. Barnes, Westminster.	E. C. Mansur, Westminster.
Belchertown,	Belchertown,	Guy C. Allen, Belchertown,	Almon L. Pratt, Belchertown.
Groton,	Groton,	W. T. Taylor, R. F. D. No. 2, Groton.	John H. Sheedy, Groton.
Holden,	Holden,	Nathan W. Sanborn, M.D., Holden.	George M. Perry, Holden.
Pepperell,	Pepperell,	William E. Chapman, Pepperell.	Leroy A. Shattuck, Pepperell.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	Fred J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boxborough,	Boxborough,	Richard Y. Nelson, Boxborough.	Geo. W. Burroughs, R. F. D., West Acton.
Buckland,	Buckland,	Charles E. Ward, Buckland.	Miss Laura E. Hite, Shelburne Falls.
Concord,	Concord,	C. W. Prescott, Concord.	Geo. M. Baker, Concord.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Horace Wells French, East Charlemont.
Easthampton,	Easthampton,	John Leitch, Easthampton.	Melville H. Lyman, Easthampton.
Franklin,	Franklin,	Geo. F. Ribrae, Franklin.	L. W. Daniels, Franklin.
Halifax,	Halifax,	James Thomas, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Medway,	Medway,	J. G. Sanderson, West Medway.	Miss Beth Wilson, Medway.
New Braintree,	New Braintree,	Edwin L. Havens, New Braintree.	Walter McCleanathan, Barre Plains.
Oakham,	Oakham,	Jesse Allen, Oakham.	Mrs. M. A. Malcolm, Oakham.
South Bristol,	New Bedford,	Elmer M. Poole, North Dartmouth.	Allen Russell, Acushnet Station, New Bedford.
Tatnuck,	Worcester,	Charles T. Foster, Hardwen Rd., Worcester.	H. Ward Moore, 28 Amherst St., Worcester.
Upton,	Upton,	Orlando F. Taft, Upton.	Edward B. Newton, Box 59, Upton.
West Brookfield,	West Brookfield,	Arthur H. Warfield, West Brookfield.	Sumner H. Reed, West Brookfield.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D., Ludlow.

Poultry Associations.

Boston Poultry Association,	Boston,	John Lowell, Chestnut Hill.	W. B. Atherton, 30 Broad St., Boston.
Dalton Poultry, Pigeon and Pet Stock Association,	Dalton,	Geo. C. Maynard, Dalton.	H. R. Messenger, Dalton.
Eastern Massachusetts Poultry and Pigeon Association,	Everett,	E. E. Tobey, Everett.	C. A. Bartlett, 16 Parker St., Melrose.

Essex County Poultry Association,	Essex County,	J. D. Barnes, Wenham.	Arthur Elliott, Peabody.
Holyoke Poultry and Pet Stock Association,	Holyoke,	F. L. Buck, 60 Pearl St., Holyoke.	John A. Stansfield, King St., Holyoke.
Lawrence Poultry and Pet Stock Association,	Lawrence,	Horace Pratt, 44 Ferry St., Lawrence.	George Bishop, Prospect St., Lawrence.
Lenox Poultry Association,	Lenox,	Wm. J. Welsh, Lenox.	Leonard H. Peters, Lenox.
Mansfield Poultry, Pigeon and Pet Stock Association.	Mansfield,	Wm. S. Harris, South Main St., Mansfield.	A. D. Leonard, 131 West St., Mansfield.
Massachusetts Poultry Association,	The State,	Geo. F. Eastman, Granby.	W. H McClary, South Hanover.
Milford Poultry Association,	Milford,	Geo. P. Sheldon, Hopedale,	W. H. Pyne, Milford.
New England Poultry Association,	Greenfield,	J. E. Weatherwax, Oak St., Greenfield.	S. H. Stone, Greenfield.
Northern Berkshire Poultry Association,	North Adams,	Wm. G. Carter, North St., North Adams.	C. M. Ottman, Hudson Brook Farm, North Adams.
Springfield Poultry Club,	Springfield,	F. W. Havens, Agawam.	H. L. Davis, 310 Whitney Building, Springfield.
Worcester Poultry Association,	Worcester,	Walter D. Ross, 90 Front St., Worcester.	Wm. H. Fitton, 42 Richmond Ave., Worcester.

Beekeepers' Societies and Associations.

Berkshire County Beekeepers' Association,	Berkshire County,	Dr. H. E. Stockwell, Stockbridge.	John Shaughnessy, Lee.
Eastern Massachusetts Society of Beekeepers,	Eastern Massachusetts,	E. Clinton Britton, Canton.	Mrs. Leslie A. M. Stewart, Franklin.
German Society for the Cultivation of Honey Bees.	Essex County,	August Seifert, Methuen.	Hugo E. Dick, Lawrence.
Hampshire, Hampden and Franklin Beekeepers' Association.	Connecticut Valley,	W. M. Purrington, Haydenville,	Dr. Burton N. Gates, Amherst.
State Beekeepers' Association of Massachusetts,	The State,	J. L. Byard, Marlborough,	Dr. Burton N. Gates, Amherst.
Worcester County Beekeepers' Association,	Central Massachusetts,	O. F. Fuller, Blackstone.	J. S. Whittemore, Leicester.

Miscellaneous.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boston Market Gardeners' Association,	Boston,	M. Ernest Moore, Arlington.	James P. Esty, Newton Center.
Brockton Agricultural Society,	Brockton,	Charles Howard, Brockton.	Perley G. Flint, Brockton.
Cape Cod Cranberry Growers' Association,	Wareham,	J. C. Makepeace, Wareham.	Lemuel C. Hall, Wareham.
Connecticut Valley Breeders' Association,	Western New England,	Prof. W. D. Hurd, Amherst.	Prof. J. A. McLean, Amherst.
Franklin Harvest Club,	Connecticut Valley,	John E. Lyman, South Hadley.	- - -
Gardeners' and Florists' Club of Boston,	Boston,	W. J. Kennedy, Chestnut Hill.	W. N. Craig, Brookline.
Hampden County Improvement League,	Hampden County,	- -	John A. Scheurle, Springfield.
Hampden Harvest Club,	Connecticut Valley,	- -	Edwin C. Powell, Springfield.
Massachusetts Cattle Owners' Association,	The State,	Chas. W. Wood, Worcester.	James L. Harrington, Lunenburg.
Massachusetts Corn Show, Inc.,	The State,	Frank P. Newkirk, Easthampton.	Edwin C. Powell, Springfield.
Massachusetts Creamery Association,	The State,	W. A. Harlow, Swift River.	Prof. W. P. B. Lockwood, Amherst.
Massachusetts Dairymen's Association,	The State,	John P. Bowditch, Framingham.	Prof. W. P. B. Lockwood, Amherst.
Massachusetts Forestry Association,	The State,	N. T. Kidder, Ames Building, Boston.	Harris A. Reynolds, 4 Joy St., Boston.
Massachusetts Fruit Growers' Association,	The State,	Harold L. Frost, Arlington.	F. Howard Brown, Hosmer St., Marlborough.
Massachusetts Nurserymen's Association,	The State,	W. H. Wyman, North Abington.	A. E. Robinson, Lexington.
Massachusetts State Poultry Association,	The State,	Geo. F. Eastman, Granby.	W. H. McClary, South Hanover.
New England Corn Exposition,	New England,	Nathaniel I. Bowditch, Framingham.	Geo. E. Stickney, Newburyport.
New England Fruit Show,	New England,	J. Lewis Ellsworth, Worcester.	Wilfrid Wheeler, Concord.
New England Nurserymen's Association,	New England,	Harlan P. Kelsey, Salem.	Charles Adams, Springfield.
Northampton Florists' and Gardeners' Club,	Northampton and Holyoke,	E. J. Canning, Northampton.	W. H. Whiting, Amherst.
Stockbridge Club,	Amherst,	R. H. Gaskill, Amherst, 15 Halleck St.	N. H. Dearing, Box 125, Amherst.
Southern New England Fair Association,	Dartmouth,	Elton S. Wilde, New Bedford.	C. T. Battey, Dartmouth.
Ware Agricultural Society,	Ware,	Fred Gilmore, Ware.	D. S. Kennedy, Ware.
West Taunton Agricultural Society,	Taunton,	Mason Marvel, Worcester St., Taunton.	Geo. A. Lincoln, 127 Walker St., Taunton.
Worcester County Harvest Club,	Worcester County,	H. P. Howland, Spencer.	Mrs. D. A. Howe, 8 Burncoat St., Worcester.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1912.

Master,	Charles M. Gardner of Westfield.
Overseer,	E. E. Chapman of Ludlow.
Lecturer,	E. F. Richardson of Millis.
Steward,	L. R. Smith of Hadley.
Assistant Steward,	E. H. Gilbert of Stoughton (P. O. address, North Easton).
Chaplain,	Rev. A. H. Wheelock, Marlborough.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton (P. O. address, North Easton).
Gate Keeper,	F. L. Warfield of Buckland.
Ceres,	Mrs. Mary Olds Lakin of Brookfield.
Pomona,	Mrs. Ella D. Rice of Leominster.
Flora,	Mrs. Laura M. Sargeant of Amesbury.
Lady Assistant Steward,	Mrs. Ida Littlefield of Norwood.

Executive Committee.

W. C. Jewett,	Worcester.
George S. Ladd,	Sturbridge.
C. A. Dennen,	Pepperell.

General Deputies.

N. B. Douglas,	Sherborn.
Elmer D. Howe,	Marlborough.
Warren C. Jewett,	Worcester.
George S. Ladd,	Sturbridge.
C. D. Richardson,	West Brookfield.

Pomona Deputies.

F. N. Boutelle,	West Townsend.
Wilbert T. Moore,	Huntington.
Joseph W. Baldwin,	North Easton.

Subordinate Deputies.

Geo. W. Sherman,	Brimfield.
Elliott M. Clemence,	Southbridge.
W. H. Sawyer,	Winchendon.
W. A. Harlow,	Cummington.
H. N. Jenks,	R. F. D., Adams.
Elbridge Noyes,	Newbury.
T. E. Flarity,	Townsend.
Moses U. Gaskill,	Mendon.
E. B. Hale,	Bernardston.
Hermon W. King,	East Longmeadow.
John Bursley,	West Barnstable.
C. R. Damon,	Williamsburg.
W. T. Herrick,	Westborough.
H. W. Carter,	Millbury.
Chester B. Williams,	Cochituate.

SUBORDINATE DEPUTIES — *Con.*

Walter E. Morris,	Medfield.
S. T. Brightman,	Westport (P. O. address, Central Village).
Horace E. Wallis,	Waltham.
Charles H. Preston,	Danvers (P. O. address, Hathorne).
Dr. M. H. Williams,	Sunderland.
Fred E. Alden,	Burbank Hospital, Fitchburg.
Norman L. Peavey,	Dracut.
Dr. Arthur W. Gorham,	North Hanson.
Peter I. Adams,	Stockbridge.
Geo. A. Witherell,	Warwick.
Harry D. Towne,	Miller's Falls (P. O. address, Orange).

SPECIAL DEPUTIES.

Wm. N. Howard,	North Easton.
John P. Ranger,	North Brookfield.
Chas. H. Shaylor,	Lee.
Geo. L. Averill,	Andover.

COMMITTEE ON BIRDS.

Raymond J. Gregory, *Chairman*,	Princeton.
George C Donaldson,	Hamilton.
Sylvester P. Robertson,	West Townsend.
Clayton E. Stone,	Lunenburg.
Mrs. E. O. Marshall,	New Salem.
Mrs. Ida Farr Miller,	Wakefield.
Mrs. Florence Butler,	East Charlemont.

RECESS COMMITTEE ON TAXATION.

Charles H. Preston,	Danvers (P. O. address, Hathorne).
John N. Hillman,	Hardwick.
Lewis B. Paine,	Dover.

TRUSTEES OF EDUCATIONAL FUND.

Evan F. Richardson, *Chairman*,	Millis.
Mrs. Rose F. Ladd, *Secretary*,	Sturbridge.
James C. Poor, *Treasurer*,	North Andover.
Charles M. Gardner,	Westfield.
John H. Noble,	Pittsfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	Joseph Mason, Newton Upper Falls.	Abel F. Stevens, Wellesley.	Mrs. Emma C. Luce, Box 45, Ashland.
Essex County, No. 2,	Fred E. Hall, Haverhill.	Albert P. Wadleigh, Merrimac.	Matilda B. Lund, Ward Hill.
Middlesex-Worcester, No. 3,	Millard S. Sawyer, Groton.	Mrs. Alice Cummings, Shirley Center.	Mrs. Minnie L. F. Knight, Townsend Harbor.
Franklin and Worcester, No. 4,	Ernest S. Putnam, Wendell Depot.	Mrs. Mabel Marsh, Orange.	Mrs. Ellen M. Conant, North Orange.
Worcester West, No. 5,	John Putnam, Baldwinville.	Mrs. Minnie Seaver, Templeton.	Rachel S. Titterton, Templeton.
Berkshire County, No. 6,	A. N. Warren, Hinsdale.	J. J. Glynn, Dalton.	Mrs. Bessie S. Wellington, 215 First St., Pittsfield.
Worcester Central, No. 7,	Everett W. Stone, Auburn.	- - -	Mrs. A. E. Grout, Millbury.
Hampshire County, No. 8,	Raymond A. Warner, Williamsburg.	Dr. M. H. Williams, Sunderland.	Mrs. C. R. Damon, Williamsburg.
Worcester Southwest, No. 9,	Fred E. Webster, Sturbridge.	Mrs. Emmagene McKinstry, Southbridge.	Mrs. Mabel Nichols, Sturbridge.
Worcester and Norfolk, No. 10,	Samuel Gaskill, South Main St., Milford.	Frank H. Wood, Mendon.	Mrs. Annie E. Gaskill, South Milford.
Borough, No. 11,	Alfred F. Ordway, Hudson.	I. Edmund Coulson, Berlin.	Mrs. Maria A. Gilmore, R. F. D. No. 2, Box 13, Westborough.
The Springfield, No. 12,	H. I. Moody, East Longmeadow.	Mrs. A. F. Ballard, Hampden.	Mrs. Carrie L. Hayward, Agawam.
Old Colony, No. 13,	J. Herbert Cushing, Middleborough.	Wm. N. Howard, North Easton.	Alida N. Stevens, 75 Tremont St., South Braintree.
Worcester East, No. 14,	J. H. Johnson, Leominster.	Mrs. Jennie M. Vinton, Worcester.	Mrs. Ida A. Cunningham, Lancaster.
Quaboag, No. 15,	John H. Webb, West Brookfield.	Charles D. Sage, New Braintree.	Miss Rachel Warren, Leicester.
Middlesex North, No. 16,	Lester R. Hayward.	Mrs. Margaret Sarre, 537 Merrimac St., Lowell.	Mrs. Francene A. Morse, Wilmington.
Deerfield Valley, No. 17,	George E. Clark, Lyonsville.	William M. Stacy, Shattuckville.	Mrs. Albert Stacy, Charlemont.
Western Hampden, No. 18,	Wilson A. Munson, Huntington.	Mrs. Millie Sanborn, Russell.	Miss Annette Sackett, Westfield.
Connecticut Valley, No. 19,	Rev. Elisha G. Hooper, Bernardston.	Mrs. Matthew Barber, Greenfield.	Mrs. Henry B. Barton, Turners Falls.
Hillside, No. 20,	B. H. Hollis, West Cummington.	C. A. Williams, Plainfield.	Mrs. G. L. Miner, East Windsor.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Swift River Valley, No. 21,	Edgar D. Winslow, Ware.	Mrs. Ella M. Winslow, Ware.	Miss Jennie P. Dodge, Enfield.
Mayflower, No. 22,	Geo. A. Estes, Halifax.	Miss Nannie B. Holmes, South Hanson.	Winthrop Fillebrown, Bryantville, R. F. D.
Middlesex Central, No. 23,	Frank Tyler Marston, 20 Fairmount St., Melrose.	E. Horace Perley, 190 Main St., Wakefield.	Frederick W. Taylor, Concord Junction.
Cape Cod, No. 24,	Robert S. Handy, Cataumet.	Frank E. Howes, Dennis.	Henry C. Davis, Cummaquid.
Berkshire South, No. 25,	L. R. Miller, Great Barrington.	Peter I. Adams, Housatonic.	Abram Dunlap, South Egremont.
Chebacco, No. 26,	Geo. C. Donaldson, South Hamilton.	Mrs. Clara F. Illsley, R. F. D., Rowley.	Mrs. Frances M. Smith, Turner Hill Farm, Ipswich.
Norfolk, No. 27,	Rev. J. C. Hall, Medfield.	Mrs. Annie R. Stowell, Walpole.	Mrs. Carrie C. Snyder, Walpole.
Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	Mr. Justus W. Stetson, Greenfield.	Mrs. Mabel R. Dwyer, Greenfield.	Mrs. Agnes M. Hanforth, Greenfield.
Deerfield, No. 2,	Whitman B. Wells, Deerfield.	Samuel P. Billings, Deerfield.	P. G. Davis, Deerfield.
Northfield, No. 3,	Robert D. Ware, Northfield.	Mrs. L. O. Clapp, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	Frank Patterson, Groton.	Mrs. Blanch Brown, Groton.	Lois M. Wright, Box 3, Groton.
Barre, No. 9,	William M. Cochran, Barre.	J. Alfred Taylor, Barre.	Mrs. Georgiana Crane, Barre.
Pittsfield, No. 14,	John Buckler, Blythewood Farms, Pittsfield.	Mrs. Grace Eisner, Bradford Building, Pittsfield.	Ralph H. Elmer, Box 1265, Pittsfield.
"Hope" of Hadley, No. 15,	E. P. West, Hadley.	Mrs. Edwin Morgan, R. F. D., Amherst.	Mrs. R. Lyman Cook, Hadley.
Amherst, No. 16,	David R. Whipple, Amherst.	Mrs. C. A. Strong, Amherst.	Miss Mary H. Scott, Amherst.
Cheshire, No. 17,	H. A. Martin, Cheshire.	Mrs. O. C. Martin, Cheshire.	Grace M. Phelps, R. F. D., Adams.
Hinsdale, No. 19,	Jesse A. Miner, Hinsdale.	H. E. Gardner, Hinsdale.	Florence Brown, Hinsdale.
Westfield, No. 20,	Wayne D. Wood, Westfield.	Mrs. Frank Phelps, Westfield.	Annette Sackett, Westfield.
Lanesborough, No. 21,	W. E. Foster, Lanesborough.	Mrs. Harriet Rice, Lanesborough.	Miss Ethel R. Wood, Lanesborough.
Worcester, No. 22,	Harold J. Greenwood, 18 Dover St., Worcester.	Mrs. Chas. A. Vaughan, Jr., 18 Dover St., Worcester.	Mrs. Nancy E. Moore, 92 Summer St., Worcester.

Dalton, No. 23,	Lyle B. Parker, Dalton.	Homer H. Bicknell, Dalton.	Lephia O. Warren, Dalton.
Blandford, No. 24,	M. H. Cooley, Chester.	C. R. Ripley, Chester.	Ira A. Aitken, Blandford.
New Lenox, No. 26,	Peter Fere, New Lenox.	Bertha S. Ford, New Lenox.	Horatio H. Sears, New Lenox.
Easthampton, No. 27,	W. H. Closson, Park St., Easthampton.	Mrs. W. B. Drury, 167 Union St., Easthampton.	Lilian Bristow, 21 Fairfield Ave., Easthampton.
Richmond, No. 32,	Arthur Reynolds, Richmond.	R. E. Annin, Jr., Richmond.	Miss Eva M. Sherman, Richmond.
Adams, No. 34,	C. A. Daniels, 18 Orchard St., Adams.	Alta Cressy, 18 Orchard St., Adams.	Lillian Daniels, 18 Orchard St., Adams.
Russell, No. 36,	A. A. Sanborn, Russell.	Mrs. A. A. Sanborn, Russell.	Mrs. G. C. Sevey, Russell.
"Thrifty" of Leverett, No. 37,	Winfred L. Woodard, Leverett.	Miss Ethel Beaman, Leverett.	Mrs. Fred Morrison, Leverett.
Granville, No. 40,	Mrs. C. A. White, Granville.	Rev. H. G. Patt, Granville.	Mrs. H. S. Harth, Granville.
Montgomery, No. 45,	Myron E. Kelso, Montgomery.	Mrs. David M. Hall, Montgomery.	Mrs. Milo E. Cushman, Montgomery.
Southwick, No. 46,	Amasa Holcomb, Southwick.	Mrs. Charles G. Stone, Southwick.	Cooley A. Griffin, Southwick.
Becket, No. 47,	H. J. Fairfield, Becket.	Mrs. A. H. Bidwell, Becket.	Mrs. A. L. Hayes, Becket.
"Highland" of Huntington, No. 48,	Mr. Oscar Lyman, Huntington.	Mr. Will Moore, Huntington.	Mrs. R. A. Jenkins, Huntington.
"Granite" of South Worthington, No. 49.	Rufus H. Adams, Ringville.	Mrs. Emma Thrasher, South Worthington.	Mrs. Lora Adams, Ringville,
"Golden Rule" of Prescott, No. 52.	Frank R. Allen, R. F. D. No. 1, Greenwich Village.	Mrs. Fanny G. Thayer, R. F. D. No. 1, Greenwich Village.	Mrs. Annis Laplante, R. F. D. No. 1, Greenwich Village.
Sterling, No. 53,	Harry A. Wiles, Sterling Junction.	Mrs. Gertrude H. Monk, Pratt's Junction.	Frank P. Elliott, Sterling.
Springfield, No. 54,	Franklin N. Newell, 31 Elm St., Springfield.	Mrs. Albina C. Barker, 15 Salem St., Springfield.	Sadie F. McVey, 23 Holyoke St., Springfield.
Cummington, No. 56,	C. A. Stevens, Cummington.	Lillie V. Bates, Cummington.	Lavantia M. Ford, Cummington.
Auburn, No. 60,	Everett W. Stone, Auburn.	Miss Bertha I. Bird, Auburn.	Arthur W. Warren, West Auburn.
Egremont, No. 63,	Frank U. Bradford, R. F. D. No. 3, Great Barrington.	Ray W. Spurr, R. F. D. No. 3, Great Barrington.	Mrs. Andrew Dunlap, R. F. D. No. 3, Great Barrington.
"Union" of Belchertown, No. 64,	William E. Shaw, Belchertown.	Alvan R. Lewis, Belchertown.	Rosabelle M. Olds, Belchertown.
Brimfield, No. 65,	Robert Sherman, Brimfield.	Fred N. Laurence, Brimfield.	Mary Hitchcock, Brimfield.
Charlemont, No. 66,	Laurence Gale, R. F. D. No. 1, Charlemont.	Sarah K. Stacy, Charlemont.	D. J. Davenport, R. F. D. No. 2, Charlemont.
Hardwick, No. 67,	Mrs. Charles Slaney, R. F. D., Gilbertville.	Mrs. J. S. Hillman, Hardwick.	Miss A. Maria Hillman, Hardwick.
Shelburne, No. 68,	W. S. Davis, Shelburne.	Mrs. W. O. Long, Shelburne.	Fred B. Dole, Shelburne.
Ashfield, No. 69,	Clark B. Sears, Williamsburg.	Mrs. Chas. A. Smith, Ashfield.	Mrs. Will H. Howes, Watson.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Phillipston, No. 70,	Walter L. Mann, Athol, R. F. D. No. 3.	D. Webster Baker, Athol, R. F. D. No. 3.	Cora A. Dunton, Phillipston.
Leyden, No. 71,	Mrs. Gratia Campbell, Greenfield.	Mrs. Ellen Williams, R. F. D., Bernardston.	Mrs. Lucy Howes, Leyden.
"Prescott" of Pepperell, No. 73,	Andrew J. Woodward, Pepperell.	Sarah B. Tucker, Pepperell.	Florence M. Flynn, Pepperell.
Princeton, No. 74,	Raymond J. Gregory, Princeton.	J. Harry Allen, Princeton.	Florence E. Bryant, Brooks Station.
Colrain, No. 76,	Frank A. Walden, Colrain.	Mrs. Henry A. Dwight, Adamsville.	Milton J. Davenport, Colrain.
Windsor, No. 77,	Sidney Coburn, Windsor.	Mrs. Jennie Coburn, Windsor.	Mrs. Belle D. Miner, East Windsor.
Holden, No. 78,	Winifred H. Stearns, Jefferson.	Mrs. Chester LaCroix, Box 203, Holden.	Mrs. W. A. Stevens, Box 96, Holden.
Spencer, No. 79,	Thomas K. Faxon, Spencer.	Mrs. Sara S. Monroe, Spencer.	Bertha M. Smith, Spencer.
Bernardston, No. 81,	Mrs. Edson W. Hale, Bernardston.	Mrs. Edwin B. Hale, Bernardston.	Mary E. Slate, Bernardston.
"Manhan" of Southampton, No. 82.	Edward K. Norris, Southampton.	Sumner S. Coleman, Southampton.	Julia E. Norris, Southampton.
Chesterfield, No. 83,	H. E. Dodge, Chesterfield.	Mrs. F. P. Baker, Bisbees.	Katherine Quinn, Chesterfield.
Warwick, No. 85,	Charles E. Stone, Warwick.	Mrs. Nellie M. Read, R. F. D. No. 2, Winchester, N. H.	Geo. A. Witherell, Orange.
North Orange, No. 86,	H. F. French, North Orange.	Mary G. Prentice, Tully.	G. A. Miller, North Orange.
Buckland, No. 87,	Herbert Keach, Buckland.	Fred L. Warfield, Buckland.	Mrs. Tella W. Wells, Shelburne Falls.
Lee, No. 88,	Duane S. Slater, Tyringham.	Mrs. W. A. Dikeman, Lee.	Mrs. H. J. Voght, Lee.
Worthington, No. 90,	Edward J. Clark, R. F. D., Cummington.	Mrs. Clarence K. Bates, R. F. D., Cummington.	Arthur G. Capen, Worthington.
Charlton, No. 92,	John G. Hammond, R. F. D., Dodge.	W. Ernest Rich, Charlton.	Mrs. Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	S. Lothrop Davenport, North Grafton.	Mrs. S. Lothrop Davenport, North Grafton.	Mrs. Eva M. Sibley, Grafton.
Petersham, No. 95,	Benj. W. Towne, Petersham.	L. Eva Summers, Petersham.	Ruby J. Stone, Petersham.
Savoy, No. 99,	Margaret McCulloch, Savoy.	Blanche McCulloch, Savoy.	Mrs. C. A. Maranville, Savoy.
Shrewsbury, No. 101,	Wesley D. Bates, Box 44, Shrewsbury.	Mrs. Gertrude M. Gates, Shrewsbury.	Mrs. M. E. Chamberlain, R. F. D., Shrewsbury.
Stow, No. 103,	Harold C. Everett, R. F. D., West Acton.	- - -	Pearl Vance, Stow.

"Garfield" of North Dana, No. 104.	Miner E. Powers, Greenwich Village.	Mrs. Marion W. Hager, North Dana.	Miss Celia Whitaker, R. F. D., North Dana.
Marlborough, No. 105,	Lambert A. Noyes, Curtis Av., Marlborough.	Mrs. Julia L. Cooley, 95 Pleasant St., Marlborough.	Mrs. Elmer D. Howe, Fair View Farm, Marlborough.
West Boylston, No. 106,	Frank H. Baldwin, Box 12, West Boylston.	Mrs. F. H. Baldwin, Box 12, West Boylston.	Mrs. M. A. Cook, Box 193, West Boylston.
Millbury, No. 107,	G. Burton Stowe, West Millbury.	Mrs. R. J. Stockwell, West Millbury.	Lloyd G. Glover, West Millbury.
Hudson, No. 108,	Alfred F. Ordway, Hudson.	Evelyn Bellis, Hudson.	Mary E. Lawrence, 55 Lincoln St., Hudson.
Sutton, No. 109,	Chester S. Jones, Sutton.	Mrs. A. W. Donaldson, Sutton.	Mrs. R. H. Richardson, Sutton.
Sherborn, No. 110,	Henry C. Goulding, Sherborn.	Aaron C. Dowse, Sherborn.	Julia N. Daniels, Sherborn.
Boylston, No. 111,	Walter A. Ridley, R. F. D. No. 83, Sterling Junction.	Mrs. Effie G. Mead, R. F. D., Boylston.	Mrs. Edna B. Garfield, R. F. D. No. 6, Boylston.
"East Medway" of Millis, No. 112,	Edward C. Smith, Millis.	Clarence E. Sampson, Millis.	Edward E. Adams, Millis.
Framingham, No. 113,	Mervin R. Parsons, R. F. D. No. 2, South Framingham.	Mrs. Lou K. Stearns, Saxonville.	George E. Fay, 35 Winter St., Framingham.
Medfield, No. 114,	Melvin R. Blood, Medfield.	Mrs. Clara H. Clark, Medfield.	Alanson H. Clark, Medfield.
Holliston, No. 115,	Justin F. Vaughan, Metcalf.	Mrs. Lottie M. Champney, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116,	Jabez A. Fisher, Route 1, Westborough.	Wm. T. Herrick, 16 Parkman St., Westborough.	Mrs. Julia H. Rogers, R. F. D. 2, Box 5, Westborough.
Dover, No. 117,	John V. Schaffner, Dover.	Mrs. Caroline McClure, Dover.	Miss Amy Gallagher, Dover.
Southborough, No. 118,	Wm. H. Onthank, R. F. D., Southborough.	Mrs. A. W. Hosmer, R. F. D., Southborough.	Mrs. Fred Wells, Fayville.
Northborough, No. 119,	Harry F. Allen, Northborough.	Mrs. Fannie B. Hildreth, Northborough.	May C. Wheeler, Northborough.
Lancaster, No. 120,	Horace E. Johnson, 1204 Main St., Clinton.	Miss Catherine Murray, Lancaster.	J. Fred Brown, South Lancaster.
Sudbury, No. 121,	Fred A. Noyes, R. F. D., South Sudbury.	Maud M. Clark, R. F. D., South Sudbury.	Geo. H. Clarke, R. F. D., South Sudbury.
Templeton, No. 122,	Walter Dwelly, Templeton.	Mrs. Alice Fairbanks, Templeton.	Mrs. Mary Rich, Templeton.
Oxford, No. 123,	Ernest O. Howe, R. F. D., Oxford.	Mary E. Rich, Oxford.	Florence P. Turner, R. F. D. No. 137, Oxford.
Ashland, No. 124,	Hiram A. Hotchkiss, Ashland.	Emma C. Luce, Ashland.	Lizzie F. Bennett, Ashland.
Upton, No. 125.,	Roy E. Smith, Upton.	Mrs. Emale Newton, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	William Clough, Hubbardston.	Ruth E. Hale, Hubbardston.	Grace R. Prentiss, Hubbardston.
Amesbury, No. 127,	Ora Beede, Merrimac.	John P. Titcomb, 111 Friend St., Amesbury.	Charles F. Tibbetts, 220 Main St., Amesbury.
North Andover, No. 128,	George A. Rea, North Andover.	Jessie Barker, North Andover.	Walter H. Hayes, North Andover.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Lincoln, No. 129,	Wm. C. Peirce, Lincoln.	Wm. C. Robus, Lincoln.	May M. Dougherty, Lincoln.
Gardner, No. 130,	Philip R. Welch, Elm St., Gardner.	Mary A. Stone, 177 Chestnut St., Gardner.	Mabel C. Bolster, 66 Glenwood St., Gardner.
Boxborough, No. 131,	Leo C. Cunningham, West Acton.	Earl H. Kathan, West Acton.	Mrs. Ada M. Durkee, West Acton.
North Brookfield, No. 132,	Mrs. J. Georgia Stoddard, North Brookfield.	Mrs. Lizzie A. Clapp, North Brookfield.	Mrs. Mary A. Howe, North Brookfield.
Berlin, No. 134,	Arthur F. Sawyer, Berlin.	I. E. Coulson, Berlin.	Bertha M. Cole, Berlin.
Norfolk, No. 135,	G. Fred Campbell, Norfolk.	Mrs. Hattie B. Day, Norfolk.	Mrs. Carrie Campbell, Norfolk.
Ipswich, No. 136,	Harry E. Murdock, North St., Danvers.	William J. Pervier, Turner Hill Farm, Ipswich.	Mrs. Helen M. Moulton, Essex Rd., Ipswich.
East Blackstone, No. 137,	Merton L. Fernald, R. F. D., Blackstone.	S. Leone Pickering, R. F. D., Blackstone.	Mrs. Bertha M. Thomas, East Blackstone.
Northampton, No. 138,	William Phillips, Hadley.	Mrs. Ida Fuller, High St., Northampton.	Mrs. Bessie Gloyd, 149 State St., Northampton.
East Sandwich, No. 139,	Ernest Cameron, Marston's Mills.	A. B. Chase, West Barnstable.	Geo. E. S. Ellis, East Sandwich.
West Boxford, No. 140,	Alfred K. Nason, West Boxford.	Katherine L. Pearl, West Boxford.	Matilda B. Lund, Ward Hill, R.F.D. No. 1.
Montague, No. 141,	Walter H. Eddy, Montague.	Mrs. Leon Ball, Montague.	Mrs. Eva G. Farnsworth, Montague.
Bolton, No. 142,	Gilbert H. Wheeler, Bolton.	Mrs. Amos C. Wheeler, Bolton.	Mrs. Arthur H. Nourse, Bolton.
Mendon, No. 143,	Roy A. Barrows, Hopedale.	Mrs. Frank H. Wood, Mendon.	Miss Lois A. Congdon, Mendon.
Franklin, No. 144,	Charles E. Adams, 65 Cottage St., Franklin.	Miss Lucy E. Tower, Grove St., Franklin.	Mrs. Susie E. Adams, 65 Cottage St., Franklin.
Douglas, No. 145,	E. D. Leonard, R. F. D., Sutton.	Mrs. Edna Ritchie, East Douglas.	Mrs. Alma Quintal, East Douglas.
West Newbury, No. 146,	Edward B. Germain, Rocks Village.	Ruth A. Ruddock, Groveland.	Harriet M. Ware, West Newbury.
West Springfield, No. 147,	Clarence E. Brockway, 31 Hanover St., West Springfield.	Mrs. Cornelia Fisher, R. F. D. No. 1, West Springfield.	Lillian M. Capron, 27 Hanover St., West Springfield.
Harvard, No. 149,	S. Henry Waters, Harvard.	Etta M. Ripley, Harvard.	Mildred E. Tooker, Littleton.
Concord, No. 150,	Norman Smith, Concord.	Mrs. W. Maria Olsen, Concord.	Miss Clara Pettigrew, Concord Junction.
East Longmeadow, No. 152,	Mervin H. Pease, East Longmeadow.	Mrs. H. W. King, East Longmeadow.	Miss Pearl E. Wood, East Longmeadow.

Wilbraham, No. 153,	E. C. Powell, R. F. D. No. 2, Ludlow.	F. E. Peck, Wilbraham.	Mrs. Edith C. Goodrich, R. F. D. No. 2, Ludlow.
Haverhill, No. 154,	Fred A. Haynes, Lowell Ave., Haverhill.	Mrs. Grace Keeler, 4 Ford St., Haverhill.	Mrs. Grace A. Merrill, 1231 Broadway, Haverhill.
Methuen, No. 155,	Edward D. Taylor, R. F. D., Methuen.	Miss Ella Hefner, Broadway, Methuen.	Miss Blanche Blodgett, Methuen.
West Bridgewater, No. 156,	Anna S. Le Lacheur, West Bridgewater.	Henry J. Le Lacheur, West Bridgewater.	Rhoda F. Wilbur, West Bridgewater.
Granby, No. 157,	Frank M. Graves, R. F. D., Granby.	Perley E. Davis, Granby.	Gladys M. Rust, Granby.
"Nemasket" of Middleborough, No. 158.	H. Arthur Standish, Middleborough.	Lizzie Morse, Middleborough.	Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159.	Richard Stevens, Williamstown.	Miss Eva Bailey, Bracewell Ave., North Adams.	Mrs. Jennie Valancourt, Williamstown.
South Hadley, No. 160,	Herbert B. Lang, South Hadley.	Mrs. Luella Howes, South Hadley.	Mrs. Eugene H. Lyman, R. F. D., South Hadley.
"Laurel" of West Newbury, No. 161.	Thomas F. Noyes, West Newbury.	Charles H. Kennett, West Newbury.	Mrs. Belle E. Kennett, West Newbury.
Dartmouth, No. 162.	Elmer E. Gifford, South Westport.	Vesta E. Strickland, South Westport.	Hannah A. Briggs, Dartmouth.
Dudley, No. 163,	George L. Penniman, Dudley.	Frank Putnam, Dudley.	Mrs. Mabel W. Merrill, Dudley.
Ware, No. 164,	F. D. Buffington, R. F. D. No. 1, Ware.	Mrs. A. C. Buffington, R. F. D. No. 1, Ware.	Miss M. R. Howard, R. F. D. No. 1, Ware.
Hampden, No. 165,	Charles I. Burleigh, Hampden.	Mrs. Catherine Flynn, Hampden.	Mrs. Mary A. Sessions, Hampden.
Wellesley, No. 166,	Cyrus F. Jenness, Waban.	G. Howard Frost, West Newton.	William A. Parks, Needham Heights.
Rowe, No. 167,	Rev. Margaret B. Barnard, Rowe.	Mrs. A. A. Shippee, Rowe.	Mrs. Anna L. Henry, Rowe.
Somerset, No. 168,	Chester B. Hathaway, R. F. D., Somerset.	Miss Lottie Willis, R. F. D., Somerset.	Miss Lois A. Davis, R. F. D., Somerset.
Lunenburg, No. 169,	William A. Warren, Lunenburg.	Lewis L. Harrington, Lunenburg.	Arthur W. Rockwood, Lunenburg.
New Braintree, No. 170,	Mrs. Julia A. Ross, 33 Irving St., West Springfield.	Mrs. Mary S. Barr, New Braintree.	Mrs. K. C. Pollard, North Brookfield.
Merrimac, No. 171,	B. Frank Sargent, R. F. D., Pond Hills, Amesbury.	Mrs. G. Mabel Walker, R. F. D., Merrimac.	Mrs. Cora L. Wadleigh, Box 149, Church St., Merrimac.
Ashby, No. 172,	Edwin Walker, Ashby.	Henrietta Willard, Ashby.	William S. Green, Ashby.
Hopkinton, No. 173,	George Mortimer, Woodville.	Mrs. Helen Phipps, Hopkinton.	Minnie R. Kilburn, Hopkinton.
Brookfield, No. 174,	Elbert L. Bemis, Brookfield.	Miss Teresa Mulvey, R. F. D., Brookfield.	Mrs. Jennie H. Bemis, Brookfield.
Athol, No. 175,	Fred R. Spaulding, Sanders St., Athol.	Mrs. Hattie F. Page, Kennebunk St., Athol.	Mrs. Fred R. Spaulding, Sanders St., Athol.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Millers River" of Orange, No. 176,	William A. Johnson, South Rd., Orange.	Mrs. Mabel Marsh, 19 Whitney St., Orange.	Henry J. Coleman, 24 Summit St., Orange.
Sturbridge, No. 177,	Arthur P. Plimpton, R. F. D., Southbridge.	Mrs. Walter Nichols, R. F. D., East Brookfield.	Mrs. Fred Webster, Sturbridge.
Ludlow, No. 179,	Chas. E. Chapman, Ludlow.	Isabel L. Chapman, Ludlow.	Mrs. Chas. Chapman, Ludlow.
West Brookfield, No. 180,	Arthur J. Sampson, West Brookfield.	Myra Sibley, West Brookfield.	Nellie M. Thacher, West Brookfield.
Westport, No. 181,	Arthur T. Potter, R. F. D., Westport.	Annie S. Brightman, R. F. D., Westport.	Chas. A. Brightman, R. F. D., Westport.
Southbridge, No. 182,	George Morse, Hook St., Southbridge.	Mrs. Susie Clemence, R. F. D. No. 2, Southbridge.	Miss Olive Barker, Coomb St., Southbridge.
Andover, No. 183,	Fred. A. Swanton, Andover.	Ira B. Hill, Andover.	Edward W. Burtt, R. F. D., Andover.
Topsfield, No. 184,	Geo. M. Tilton, R. F. D., Topsfield.	Anna B. Jordan, Topsfield.	A. G. Bradstreet, R. F. D., Topsfield.
Fitchburg, No. 186,	Fred E. Alden, Burbank Hospital, Fitchburg.	Mrs. Marion E. Sarkin, 60 Boutelle St., Fitchburg.	Mrs. Nettie E. Woodman, 487 Water St., Fitchburg.
Littleton, No. 188,	Chas. A. Kimball, Littleton.	Mrs. Lura J. Wright, Littleton.	Miss Augusta W. Smith, Box 147, Littleton Common.
Warren, No. 189,	Chas. E. Bliss, Warren.	Laura B. Covell, Warren.	Flora Belle Patrick, Warren.
Bellingham, No. 190,	Frank C. Albee, South Milford.	Ethel Scott, 6 Leonard St., Milford.	Olive M. Clark, Bellingham.
Winchendon, No. 192,	Willie W. Lord, Winchendon.	L. Gertrude Noyes, Winchendon.	Charles W. Brooks, Winchendon.
Foxborough, No. 193,	Walter S. Mann, R. F. D., Foxborough.	Ralph A. Littlefield, Foxborough.	Nellie F. Capen, Foxborough.
Townsend, No. 194,	T. E. Flarity, Townsend.	Mrs. Minnie L. Knight, Townsend.	Mrs. Flora I. Atwood, Townsend.
Royalston, No. 195,	Alfred H. Brown, Royalston.	Charles E. Richardson, Royalston.	Chas. H. Brown, Royalston.
Easton, No. 196,	Herbert C. Marshall, R. F. D., North Easton.	Hattie L. Hayes, R. F. D., North Easton.	Emily M. Drew, 11 Grafton St., Brockton.
"Brookville" of Holbrook, No. 197.	J. Fred Gill, Avon.	Alida R. Gill, Avon.	Cora Shaw, Howard St., Montello.
Leominster, No. 198,	Andrew Thompson, R. F. D. No. 1, Fitchburg.	Mrs. Grace Brock, 288 Highland Ave., Leominster.	Mrs. Lilla King, 27 Summer St., Leominster.

Stoughton, No. 199,	Ernest H. Gilbert, R. F. D., North Easton.	Miss Ella S. Henry, Central St., West Stoughton.	Mrs. Jennie M. Spaulding, 1716 Central St., West Stoughton.
Uxbridge, No. 200,	Leon B. Pease, Whitinsville.	Mrs. Bertha Ramsey, Uxbridge.	Helen J. Hollis, Uxbridge.
Bridgewater, No. 201,	Geo. W. Cutler, R. F. D. No. 3, Bridgewater.	Helen Perkins, 242 Main St., Bridgewater.	Jennie V. Parry, R. F. D. No. 1, Bridgewater.
Ashburnham, No. 202,	Ernest W. Lawrence, Ashburnham.	Mrs. S. Esther Lawrence, Ashburnham.	Mrs. Sadie M. Fosgate, Ashburnham.
Westminster, No. 203,	Hervey W. Bell, R. F. D. No. 1, Westminster.	Emma Richardson, Westminster Center.	Lizzie E. Baker, R. F. D., Box 40, Westminster.
Rowley, No. 204,	Daniel H. O'Brien, R. F. D. No. 1, Rowley.	Miss Minnie Blagden, Box 112, Rowley.	John A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Herbert Le May, Marshfield.	Mrs. Annie Blackman, Marshfield.	Frank T. Harlow, Marshfield.
Tewksbury, No. 207,	Percy Lewis Haines, R. F. D. No. 1, North Billerica.	Mrs. G. A. Norris, Tewksbury.	Mrs. Olive M. Clark, 8 Western Ave., Lowell.
Westford, No. 208,	W. R. Taylor, R. F. D. No. 1, Westford.	Grace Lumbert, Westford.	Mrs. F. C. Wright, R. F. D. No. 1, Westford.
Hanson, No. 209,	Arthur H. Gadd, R. F. D., Bryantville.	Nannie B. Holmes, R. F. D., South Hanson.	Nan S. Harley, South Hanson.
Chicopee, No. 211,	Harold J. Baldwin, 143 Chicopee St., Chicopee.	Mrs. Arthur Megargel, Chicopee St., Chicopee.	Mrs. Minnie A. Baldwin, 143 Chicopee St., Chicopee.
"Oak Hill" of Attleborough, No. 212.	S. W. Cash, R. F. D. No. 1, Attleborough.	H. E. Carpenter, Attleborough.	Mrs. M. P. Smith, Locust St., R. F. D. No. 4, Attleborough.
"Massapoag" of Sharon, No. 213,	Sidney P. Hull, Sharon.	Miss Laura Stothart, Sharon.	Georgie B. Brown, Sharon.
Walpole, No. 214,	Geo. E. Shepard, Walpole.	Edmund Grover, East Walpole.	Carrie C. Snyder, Box 372, Walpole.
Mattapoisett, No. 215,	Henry T. Howard, East Fairhaven.	Miss Abbie S. Westgate, R. F. D., Box 2, Mattapoisett.	Dr. Walter E. Blaine, Box 251, Mattapoisett.
Dracut, No. 216,	Bert A. Cluff, R. F. D. No. 2, Lowell.	Mrs. Margaret A. Sarre, 537 Merrimac St., Lowell.	Mrs. Florence M. Weinbeck, 192 Wentworth Ave., Lowell.
Norton, No. 218,	Alden G. Walker, Norton.	Allison J. Cowles, Norton.	Miss Nellie H. Lincoln, East Norton.
East Princeton, No. 219,	Winfred E. Drury, Princeton.	J. H. Gates, Pratt's Junction.	Mrs. Bessie French, East Princeton.
Sunderland, No. 220,	F. O. Williams, Sunderland.	Mrs. I. A. Hoxie, Sunderland.	Ruth I. Clark, Sunderland.
"Anawan" of Rehoboth, No. 221,	Harold A. Goff, R. F. D. No. 1, Attleborough.	Frank L. Thomas, Rehoboth.	Clara Thomas, Rehoboth.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Tyngsborough, No. 222,	Murray Parrish, R. F. D., Tyngsborough.	Raymond W. Sherburne, R. F. D., Tyngsborough.	Norman R. Sherburne, R. F. D., Tyngsborough.
Billerica, No. 223,	Harry F. Waite, R. F. D., Bedford.	Mrs. Forest F. Collier, Billerica.	Josiah C. Folsom, Billerica.
Sheffield, No. 224,	George A. Scott, Sheffield.	Mrs. Augusta V. Palmer, R. F. D. No. 1, Sheffield.	Edwin H. Cande, Box 65, Sheffield.
Williamsburg, No. 225,	Leon Sanderson, Florence.	Mrs. C. H. Church, Williamsburg.	Harry W. Warner, R. F. D., Haydenville.
West Medway, No. 226,	James B. Beers, Box 428, West Medford.	Alice D. Esten, West Medford.	A. Annettea Hayward, Box 402, West Medway.
Heath, No. 227,	Oscar R. Thompson, Heath.	Mrs. F. E. Stetson, Heath.	Mrs. Bessie A. Carraker, Heath.
Salisbury, No. 228,	Edward H. MacConnell, Salisbury.	George E. Dow, Salisbury.	Frances Bragg, Salisbury.
Cochituate, No. 229,	Alexander W. Holmes, Cochituate.	Sidney Loker, Cochituate.	Gertrude D. Bishop, Cochituate.
Taunton, No. 230,	John Wade, Burt St., Taunton.	Mrs. John Wade, Burt St., Taunton.	D. Thurber Wood, Segregansett.
"Ponkapoag" of Canton, No. 231,	Isabelle C. McIntyre, 168 River St., Mattapan.	Walter W. Shaw, Ponkapoag.	Arthur E. Estey, R. F. D., Canton.
Plainfield, No. 232,	Ralph Gloyd, Plainfield.	Mrs. Eugene Thatcher, Plainfield.	Mrs. N. K. Lincoln, Plainfield.
Lexington, No. 233,	Edwin W. Hutchinson, Blossom St., Lexington.	George F. Reed, Parker St., Lexington.	Edith M. Hutchinson, Blossom St., Lexington.
Newbury, No. 234,	William C. Noyes, R. F. D., Rowley.	Ethel L. Chase, Curzon Mill Rd., Newburyport.	Joseph D. Rolfe, 30 East High St., Newbury.
Oakham, No. 235,	Effie T. Swindell, Oakham.	Richard V. Malcolm, Oakham.	Sara E. Butler, Oakham.
"Quascacunquen" of Byfield, No. 236.	Harold L. Bailey, Byfield.	George E. Smith, Byfield.	Jesse N. Towne, R. F. D., Rowley.
Groveland, No. 237,	Matthew N. Currier, Groveland St., Haverhill.	Mrs. Annie Cook, Highland Ave., Groveland.	Miss M. Lottie Tuttle, 149 Main St., Groveland.
Bradford, No. 238,	Arthur Barteaus, Bradford.	Elizabeth Hunt, 28 Washington Sq., Haverhill.	Grace F. Pierce, 4 New St., Bradford.
North Reading,	Fred A. Childs, North Reading.	Mrs. Eva M. Ellenwood, Reading.	Lester R. Hayward, South Middleton.

Palmer, No. 241,	C. W. Carpenter, Monson.	Mrs. Bessie M. Pelton, Monson.	Mrs. E. J. Freeman, Palmer.
Rutland, No. 242.	Louis M. Hauff, Rutland.	Sarah J. Munroe, Rutland.	Frances P. Hauff, Rutland.
Enfield, No. 243,	Miss Jennie P. Dodge, Enfield.	Miss Dora Foley, Enfield.	Mrs. Leon Downing, R. F. D., Enfield.
Chelmsford, No. 244,	Walter S. Holder, Chelmsford.	Eliza Spaulding, Chelmsford.	Harlan E. Knowlton, Chelmsford.
Greenwich, No. 245,	Fred F. Newcomb, R. F. D. No. 2, Ware.	Miss M. Louise Edson, R. F. D. No. 2, Ware.	Miss Helen Hall, R. F. D. No. 2, Ware.
West Stockbridge and Alford, No. 246.	E. A. Easland, R. F. D. No. 1, State Line.	T. L Curran, R. F. D. No. 1, Housatonic.	A. R. Hensel, R. F. D. No. 1, State Line.
"Harmony" of Easton, No. 247,	Wilmarth P. Howard, R. F. D., South Easton.	Mrs. Edith R. Pierce, R. F. D., South Easton.	Jennie M. Goss, Easton.
Wendell, No. 248,	Frank Ballon, Wendell.	Harry Thayer, Wendell.	Bessie Stafford, Wendell.
Baldwinsville, No. 249,	Walter A. Stockwell, Baldwinsville.	John H. Putnam, Baldwinsville.	Ruby Lund, Baldwinsville.
Everett, No. 250,	Thomas E. Carter, 98 Converse Ave., Malden.	Mrs. Winnie Whitcomb, 156 Chestnut St., Everett.	C. E. Dinslow, 116 High St., Everett.
West Tisbury, No. 251,	James F. Adams, West Tisbury.	Evelyn M. Adams, West Tisbury.	Frederick G. Vincent, West Tisbury.
"Wachusett" of Leominster, No. 252.	B. M. Vinton, 18 Haynes Ct., Leominster.	Mrs. Ella Harris, 100 Granite St., Leominster.	Emma L. Hatstat, Union St., Leominster.
Halifax, No. 253,	Anson A. Anderson, Halifax.	James Thomas, Halifax.	Mrs. H. Ramsdell, Halifax.
Shirley, No. 254,	George H. Farmer, R. F. D., Shirley.	Mrs. Bessie Buxton, R. F. D., Shirley.	Miss Margaret Evans, R. F. D., Shirley.
Chilmark, No. 255,	Henry H. Allen, Chilmark.	Mrs. Ruth H. Mayhew, Chilmark.	Mrs. Leona B. Vincent, Chilmark.
New Salem, No. 256,	Fred F. Ballard, Millington.	Mrs. Elitha W. Haskell, Millington.	Mrs. Geneva Sieg Ballard, Millington.
Rochester, No. 257,	Benj. F. Hodgson, R. F. D., Marion.	Mrs. Annie Cowen, R. F. D., Rock.	George T. Parker, R. F. D., Acushnet.
Carlisle, No. 258,	Harold T. Chamberlain, Carlisle.	Mrs. Nettie O. Wilson, Carlisle.	Grace H. Chamberlain, Carlisle.
Acton, No. 259,	Charles I. Miller, North Acton.	Mrs. J. Sidney White, North Acton.	Miss Ella L. Miller, North Acton.
Dennis, No. 260,	Gerard Chapman, Dennis.	Frank E. Howes, Dennis.	Nathan Crowell, East Dennis.
East Charlemont, No. 261,	Mrs. S. S. Thatcher, East Charlemont.	Mrs. Florence Butler, East Charlemont.	Mrs. Alo. J. Hager, East Charlemont.
Braintree, No. 262,	Charles W. Matthews, East Braintree.	Lawson B. Twitchell, East Braintree.	Miss Mildred F. Dyer, Pond St., South Braintree.
Danvers, No. 263,	George D. Hooper, 67 Wenham St., Danvers.	Elmer E. Allen, 370 Newbury St., Danvers.	Loring B. Goodale, 90 Center St., Danvers.
"Quinobequin" of Medway, No. 264.	Mrs. Eva E. Mason, Medway.	Miss Margaret Bodge, Medway.	Mrs. Cynthia C. Albee, Box 374, Medway.
Great Barrington, No. 265,	Leonard R. Miller, Great Barrington.	Frank A. Minkler, Great Barrington.	Charles T. Kellogg, Great Barrington.
"Hill Top" of Windsor, No. 267,	A. L. Turner, Windsor.	Mrs. D. A. Cady, Dalton.	Rev. R. H. Abercrombie, Windsor.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Wilmington, No. 268,	Eli T. Kinsman, Wilmington.	Dorothea Neilson, Wilmington.	Francene A. Morse, Wilmington.
"Mill River" of New Marlborough, No. 269.	Henry P. Comstock, New Marlborough.	Mrs. Jessie Spooner, New Marlborough.	Mrs. Nellie Comstock, New Marlborough.
South Weymouth, No. 270,	John E. Inkley, East Weymouth.	Thomas V. Nash, South Weymouth.	Mrs. Thomas V. Nash, South Weymouth.
Milford, No. 271,	Wm. J. Keith, Milford.	Wm. P. Greenwood, Milford.	Minnie B. Wilcox, South Milford.
Brewster, No. 272,	Franklin B. Crocker, North Brewster.	Rev. Edw. S. Cotton, Brewster.	Mrs. E. F. Hamblin, East Brewster.
Shutesbury, No. 273,	Chester N. Tupper, Shutesbury.	Mrs. Lizzie Crossman, Shutesbury.	Margaret Haskell, Shutesbury.
Westwood, No. 274,	William H. McLaren, High St., Westwood.	Mrs. Catherine M. E. White, Nahatan St., Westwood.	Miss Carrie L. Mylod, High St., Westwood.
Westhampton, No. 275,	Francis A. Loud, Westhampton.	Mrs. Ellen L. Allyn, R. F. D. No. 2, Northampton.	George E. Clapp, R. F. D. No. 2, Northampton.
"Ware Valley" of Ware, No. 276,	Edgar D. Winslow, Ware.	Mrs. Ella Winslow, Ware.	W. Winslow Gibbs, R. F. D. No. 1, Ware.
Plympton, No. 277,	Harold I. Moore, Plympton.	Mrs. Lillian D. Page, Plympton.	Miss Nellie F. Sherman, Plympton.
Gill, No. 278,	Lewis C. Munn, R. F. D. No. 1, Gill.	Mrs. F. D. Jones, Riverside, R. F. D. No. 1, Gill.	Ernest G. Atherton, R. F. D. No. 1, Gill.
Newburyport, No. 279,	Charles E. Ross, 19 Arlington St., Newburyport.	Luella D. Gove, Turkey Hill Rd., Newburyport.	Katherine W. Gillett, 54 Purchase St., Newburyport.
"Pocasset" of Bourne, No. 280,	Herman P. Handy, Cataumet.	Mrs. Lena Fuller, Cataumet.	Charles H. Scott, Cataumet.
Vineyard Haven,	Mrs. Lizzie P. Walker, Box 635, Vineyard Haven.	Mrs. Carrie B. Hammet, Vineyard Haven.	Mrs. Jennie W. Robinson, Vineyard Haven.
Waltham, No. 282,	Chas. J. R. Cahill, Beaver St., Waltham.	Norman Jacobsen, 31 Elm Ave., Waltham.	Miss Jennie W. Graham, 61 Adams St., Waltham.
Bedford, No. 283,	John R. Comley, Bedford.	Mrs. Fred F. Cook, Bedford.	Mrs. Luella F. Sweetnam, Bedford.
East Bridgewater, No. 284,	Ralph W. Seymour, R. F. D., East Bridgewater.	John K. Alexander, R. F. D., East Bridgewater.	Chas. D. Meservey, R. F. D. No. 1, Whitman.
Acushnet, No. 285,	Dr. Joel P. Bradford, Acushnet Station, New Bedford.	Eliza B. Bradford, Acushnet Station, New Bedford.	John Geggatt, Jr., Acushnet Station, New Bedford.

West Gloucester, No. 286,	Ephraim R. Andrews, R. F. D. No. 1, Gloucester.	Miss Lou E. Low, 72 Western Ave., Gloucester.	Miss Mary L. Coleman, R. F. D. No. 1, Gloucester.
Woburn, No. 287,	Hadley F. Higgins, 143 Pleasant St., Woburn.	Miss Catherine McCarron, 57 Harrison Ave., Woburn.	Miss Margaret Hearn, 51 Harrison Ave., Woburn.
Duxbury, No. 288,	J. Knowles Parker, Duxbury.	Henry A. Fish, South Duxbury.	Leona T. Peterson, Millbrook.
Yarmouth, No. 289,	Thos. S. Crowell, Yarmouthport.	Henry C. Davis, Cummaquid.	Gorham Pulsifer, Yarmouthport.
Norwood, No. 290,	C. Hallowell, Norwood.	C. O. Littlefield, Norwood.	W. H. Holbrook, Norwood.
Monterey, No. 291,	Andrew J. Hall, Monterey.	Minnie M. Hall, Monterey.	Jared B. Thomson, Monterey.
Saugus, No. 292,	Carl Koch, Broadway, Saugus.	Mrs. E. A. Moses, R. F. D. No. 1, Saugus.	Miss Martha Jackson, Adams Ave., Saugus.
Wakefield, No. 293,	James W. Glover, 66 West Chestnut St., Wakefield.	Miss Barbara Miller, 18 Lawrence St., Wakefield.	Mrs. Ida F. Miller, 18 Lawrence St., Wakefield.
Georgetown, No. 294,	Frank A. Jones, Georgetown.	Mrs. Clara E. Illsley, R. F. D., Rowley.	Alice P. Thayer, Georgetown.
Stockbridge, No. 295,	Peter I. Adams, Housatonic.	Mrs. Fannie P. Benjamin, Stockbridge.	S. Albert Noble, Stockbridge.
Millers Falls, No. 296,	Harry D. Towne, Millers Falls.	Mrs. Francis Pickett, Millers Falls.	Frederick L. Pomeroy, Millers Falls.
Hamilton-Wenham, No. 297,	Cullen S. Thrasher, Hamilton.	Geo. W. Preston, Wenham St., Danvers.	Joseph Lynch, Wenham.
Boxford, No. 298,	Chester Killam, East Boxford.	Miss Amy G. Parkhurst, Boxford.	Miss Bertha Perley, Boxford.
Hingham, No. 299,	James G. Lovell, R. F. D., Hingham.	Fannietta Lovell, R. F. D., Hingham.	B. L. Blanchard, Box 43, Hingham Center.
Ayer, No. 300,	Frederick T. Auld, Ayer.	Mrs. Grace M. Rymes, Ayer.	Mrs. Carrie M. Williams, Ayer.
Whitman, No. 301,	Mrs. Addie R. Lawrence, 121 School St., Whitman.	Miss Hattie M. Thompson, 23 Burton Ave. Whitman.	Miss Grace M. Lawrence, 121 School St., Whitman.
Pembroke, No. 302,	Charles F. Howe, Bryantville.	Ethel M. Graham, Bryantville.	Louis A. Sherman, Pembroke.
Weston, No. 303,	Herbert E. Tyler, Kendall Green.	J. Melvin Schwartz, Weston.	Joseph R. Roberts, Weston.
Whately, No. 304,	Montville L. Crafts, Whately.	Mrs. Wm. L. Stripp, R. F. D., Haydenville.	Howard R. Waite, Whately.
West Peabody, No. 305,	Walter H. Brown, West Peabody.	Charles H. Smith, Lynnfield.	Bessie C. Taylor, West Peabody.
Beverly, No. 306,	Gilbert A. Kimmens, Brimbal Ave., Beverly.	Lawrence Perkins, 33 Budleigh Ave., Beverly.	Albert S. Hall, 391 Cabot St., Beverly.
East Freetown, No. 307,	Harris E. Chace, Clifford.	Emily A. Delano, Clifford.	Louise B. Chace, Clifford.
Eastham, No. 308,	Lester G. Horton, North Eastham.	Mrs. H. M. Sullivan, Eastham.	Mrs. Bessie Handy, Eastham.
Paxton, No. 309,	Herbert S. Robinson, Paxton.	Victor A. Blackmer, Paxton.	Mrs. Sara H. Graton, Paxton.
Middlefield, No. 310,	John T. Bryan, R. F. D. No. 2, Chester.	Henry S. Pease, R. F. D. No. 2, Chester.	Mrs. Gertrude Pease, Middlefield.
Raynham Center, No. 311,	David F. Carr, Raynham Center.	Berton F. Mowry, Raynham Center.	Mrs. Grace Turner, Raynham Center.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Rockland, No. 312,	Edward H. Williams, 202 Central St., Rockland.	Mrs. Winnona F. Williams, 202 Central St., Rockland.	Robert Dwelley, South Hanover.
Northbridge, No. 313,	Jacob A. Williams, Northbridge.	Mrs. Jennie E. Heath, 27 Forest St., Whitinsville.	Miss Mary J. Brown, 41 Prospect St., Whitinsville.
"Dighton Rock" of Dighton, No. 314.	Hiram O. Palmer, Dighton.	Mrs. L. J. Wade, Dighton.	Howard C. Briggs, Segreganset.
Mansfield, No. 315,	Walter P. Sheridan, Oakland Ave., Mansfield.	Harrison A. Morse, 107 South Dean St., Mansfield.	Miss Harriet J. Buck, 140 Pratt St., Mansfield.
Randolph, No. 316,	J. Harry Mason, Randolph.	Rev. John N. Shipman, Randolph.	Raymond L. Mason, Randolph.

INDEX.

INDEX.

Public Document No. 31

TWENTY-FIFTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

PART I.,

BEING PART III. OF THE FIFTIETH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1913.

ENDING THE THIRTIETH YEAR FROM THE FOUNDING OF THE STATE AGRICULTURAL EXPERIMENT STATION.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
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1913.

Approved by
The State Board of Publication.

TWENTY-FIFTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

PART I.

DETAILED REPORT OF THE EXPERIMENT STATION.

A RECORD OF THE THIRTIETH YEAR FROM THE FOUNDING OF THE STATE AGRICULTURAL EXPERIMENT STATION.

INTRODUCTION.

In accordance with the provision of the act of the Legislature relative to the publication of the reports of the Massachusetts Agricultural College, the report of the experiment station, which is a department of the college, is presented in two parts. Part I. contains the formal reports of the director, treasurer and heads of departments, and papers of a technical character giving results of research work carried on in the station. This will be sent to agricultural colleges and experiment stations and to workers in these institutions as well as to libraries. Part I. will be published also in connection with the report of the Secretary of the State Board of Agriculture, and will reach the general public through that channel. Part II. will contain papers of a popular character, and will be sent to all those on our general mailing list, as well as to agricultural colleges and experiment stations, to workers in these institutions and to libraries in Massachusetts.

FRED W. MORSE,

Acting Director.

CONTENTS.

Part I.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

TWENTY-FIFTH ANNUAL REPORT

PART I.

ORGANIZATION.

Committee on Experiment Department.

CHARLES H. PRESTON, *Chairman.*
J. LEWIS ELLSWORTH.
ARTHUR G. POLLARD.
CHARLES E. WARD.
HAROLD L. FROST.
THE PRESIDENT OF THE COLLEGE, *ex officio.*
THE DIRECTOR OF THE STATION, *ex officio.*

Station Staff.

WILLIAM P. BROOKS, Ph.D., *Director.*[1]
FRED W. MORSE, M.Sc., *Acting Director.*
JOSEPH B. LINDSEY, Ph.D., *Vice-Director.*
FRED C. KENNEY, *Treasurer.*

Department of Plant and Animal Chemistry.

JOSEPH B. LINDSEY, Ph.D., *Chemist.*
EDWARD B. HOLLAND, M.Sc., *Associate Chemist, in charge of Research Division.*
FRED W. MORSE, M.Sc., *Research Chemist.*
HENRI D. HASKINS, B.Sc., *In charge of Fertilizer Section.*
PHILIP H. SMITH, M.Sc., *In charge of Feed and Dairy Section.*
LEWELL S. WALKER, B.Sc., *Assistant.*
JAMES C. REED, B.Sc., *Assistant.*
RUDOLPH W. RUPRECHT, B.Sc., *Assistant.*
GEORGE R. PIERCE, B.Sc., *Assistant.*[2]
CARLETON P. JONES, B.Sc., *Assistant.*
CARLOS L. BEALS, B.Sc., *Assistant.*
JAMES T. HOWARD, *Collector.*
HARRY J. ALLEN, *Laboratory Assistant.*
JAMES R. ALCOCK, *Assistant in Animal Nutrition.*

---

[1] On leave. [2] Resigned.

Department of Agriculture.

William P. Brooks, Ph.D., *Agriculturist.*[1]
H. J. Franklin, Ph.D., *In charge of Cranberry Investigations, Wareham.*
Edwin F. Gaskill, B.Sc., *Assistant.*

Department of Horticulture.

Frank A. Waugh, M.Sc., *Horticulturist.*
Fred C. Sears, M.Sc., *Pomologist.*
Jacob K. Shaw, Ph.D., *Research Assistant.*
Howard A. Turner, B.Sc., *Graduate Assistant.*[2]

Department of Vegetable Physiology and Pathology.

George E. Stone, Ph.D., *Vegetable Physiologist and Pathologist.*
George H. Chapman, M.Sc., *Research Assistant.*
Edward A. Larrabee, B.Sc., *Assistant.*

Department of Entomology.

Henry T. Fernald, Ph.D., *Entomologist.*
Burton N. Gates, Ph.D., *Apiarist.*
Arthur I. Bourne, B.A., *Assistant.*

Department of Veterinary Science.

James B. Paige, B.Sc., D.V.S., *Veterinarian.*

Department of Meteorology.

John E. Ostrander, A.M., C.E., *Meteorologist.*
H. W. Angier, *Observer.*

Other Officers of the Experiment Station.

Charles R. Green, B.Agr., *Librarian.*
Herbert J. Baker, B.Sc., *Secretary to the Director.*[2]
Benjamin G. Southwick, B.Sc., *Secretary to the Director.*[2]
Mrs. Lucia G. Church, *Stenographer to the Director.*
Miss Alice M. Howard, *Stenographer, Department Plant and Animal Chemistry.*
Miss F. Ethel Felton, *Stenographer, Department Plant and Animal Chemistry.*
Miss Lina Fisher, *Stenographer, Department Plant and Animal Chemistry.*
Miss Jessie V. Crocker, *Stenographer, Department of Vegetable Physiology and Pathology.*
Miss Bridie E. O'Donnell, *Stenographer, Department of Entomology.*
Miss Grace E. Gallond, *Stenographer, Department of Agriculture.*

---

[1] On leave. [2] Resigned.

PUBLICATIONS DURING 1912.

Annual Report.

Twenty-Fourth Annual Report, Part I., 287 pages; Part II., 90 pages.

Separata from Annual Report.

Report of Entomologist, 8 pages.
Insects of the Year 1911, 4 pages.
Report of the Botanist, 108 pages.
Chemistry of Arsenical Insecticides, 36 pages.
Cranberry Substation, 12 pages.
Heredity, Correlation and Variation in Garden Peas, 22 pages.

Bulletins.

No. 140. Inspection of Commercial Fertilizers, by H. D. Haskins, L. S. Walker, J. F. Merrill and R. W. Ruprecht, 86 pages.
No. 141. The Microscopic Identification of Cattle Foods, by G. H. Chapman, 71 pages.
No. 142. Inspection of Commercial Feed Stuffs, by P. H. Smith, G. R. Pierce and R. W. Ruprecht, 48 pages.

Circulars.

No. 32. An Act to regulate the Sale of Commercial Fertilizers, 4 pages.
No. 33. An Act to regulate the Use of Utensils for testing the Composition or Value of Milk and Cream, 11 pages.
No. 34. An Act to regulate the Sale and Analysis of Food Stuffs used for Live Stock and Poultry, 7 pages.
No. 22. (Reprint) Poultry Manures, their Use and Treatment, 4 pages.
Meteorological Bulletins, 12 numbers, 4 pages each.

REPORT OF THE TREASURER.

ANNUAL REPORT

Of Fred C. Kenney, Treasurer of the Massachusetts Agricultural Experiment Station of the Massachusetts Agricultural College,

For the Year ending June 30, 1912.

United States Appropriations, 1911–12.

	Hatch Fund.	Adams Fund.
Dr.		
To receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1912, under acts of Congress approved March 2, 1887 (Hatch fund), and March 16, 1906 (Adams fund),	$15,000 00	$15,000 00
Cr.		
By salaries,	$8,908 04	$12,650 33
labor,	2,568 46	836 74
publications,	261 38	–
postage and stationery,	375 76	53 47
freight and express,	119 60	22 82
heat, light, water and power,	91 68	71 76
chemicals and laboratory supplies,	111 11	167 75
seeds, plants and sundry supplies,	661 28	223 57
fertilizers,	439 80	71 25
feeding stuffs,	689 43	–
library,	91 08	2 00
tools, machinery and appliances,	30	8 40
furniture and fixtures,	164 37	417 70
scientific apparatus and specimens,	297 90	308 68
live stock,	26 00	–
traveling expenses,	129 75	24 95
contingent expenses,	15 00	–
buildings and land,	49 06	140 58
Total,	$15,000 00	$15,000 00

State Appropriation, 1911–12.

Cash balance brought forward from last fiscal year,	$886 90	
Cash received from State Treasurer,	16,875 00	
fertilizer fees,	10,277 00	
farm products,	6,613 10	
miscellaneous sources,	8,143 69	
		$42,795 69
Cash paid for salaries,	$15,024 62	
labor,	8,909 03	
publications,	1,387 85	
postage and stationery,	1,004 80	
freight and express,	166 67	
heat, light, water and power,	252 91	
chemicals and laboratory supplies,	772 41	
seeds, plants and sundry supplies,	1,736 42	
fertilizers,	504 16	
feeding stuffs,	1,142 96	
library,	260 56	
tools, machinery and appliances,	274 79	
furniture and fixtures,	316 04	
scientific apparatus and specimens,	378 87	
live stock,	5 00	
traveling expenses,	2,785 85	
contingent expenses,	190 00	
buildings and land,	895 47	
balance,	6,787 28	
		$42,795 69

REPORT OF THE DIRECTOR.

FRED W. MORSE, ACTING DIRECTOR.

The Agricultural Experiment Station has been unfortunate in the loss of the services of its director during the latter part of the year. Dr. Brooks was obliged to relinquish his work on account of ill health, and accept a leave of absence beginning July 1.

Vice-Director J. B. Lindsey, who acted by appointment from July 1 to October 1, found his duties as chief of the division of chemistry, in both college and experiment station, too arduous and exacting to be combined with those of the director. The trustees accordingly appointed Fred W. Morse acting director on October 1.

There have been several changes among the junior members of the station staff. Mr. Herbert J. Baker resigned his position as secretary to the director on July 1, and accepted a position with the office of farm management in the United States Department of Agriculture. He was succeeded in the experiment station by Mr. Benjamin G. Southwick, but just at the end of the year Mr. Southwick resigned to take a more responsible position in practical agriculture, and the position will remain unfilled until the return of the director.

In the department of plant and animal chemistry, Mr. George R. Pierce, Mr. Carleton P. Jones and Mr. Carlos L. Beals were appointed assistants, the first-named in the feed and dairy section and the others in the fertilizer section. Mr. Pierce resigned at the end of the year, to go to Cuba, where he is employed in a sugar-house. Miss Lina Fisher has been employed in conjunction with the college, to serve for half of the time as stenographer in the feed and dairy section.

In the horticultural department, Mr. Howard A. Turner was

appointed July 1 to the position of graduate assistant in plant-breeding, but soon resigned to accept a position with the office of farm management, and the former position has remained vacant.

Miss Grace E. Gallond has been appointed stenographer in the department of agriculture and Mr. H. W. Angier has succeeded Mr. R. W. Hallowell as observer in the meteorological department. Just before the close of the year, Mr. H. D. Goodale of the Carnegie Laboratory, at Cold Spring Harbor, N. Y., was appointed research biologist in poultry-husbandry, to begin work on Feb. 1, 1913.

At the last session of the Legislature the annual appropriation for the maintenance of the experiment station was increased from $10,500 to $15,000, to become available at the beginning of the new fiscal year, Dec. 1, 1913. The trustees have assigned nearly the whole increase to the department of poultry-husbandry, and Prof. John C. Graham has been appointed head of the department, without salary from the experiment station.

The growth of the experiment station has developed a need of more land, and the trustees have deemed it the wiser policy to meet these needs by leasing satisfactory tracts in the vicinity. Two tracts have accordingly been leased, viz., a lot of twenty acres from Mrs. Mary E. Tuxbury for orchard experiments, and a tract of two acres from Mrs. Winifred Tripp for a fertilizer experiment with basic slag phosphate.

The work of the experiment station has continued without interruption along the lines described in the last annual report, and no new investigations have been undertaken; but plans have been adopted for experiments in breeding poultry with the aid of the additional State funds. The details of the progress in the different investigations will be found in succeeding pages reported by the officers who have been respectively intrusted with them.

The asparagus field at the Concord asparagus substation has produced its fourth crop this year. Mr. C. W. Prescott, in charge of the substation, reported an excellent yield amounting to a gross weight of 11,141 pounds of shoots for the whole area of two acres.

The fertilizer experiments on asparagus so far have shown positively that the use of chemical fertilizers alone has maintained the plots so treated at a somewhat higher productiveness than the combination of chemicals with stable manure. There is some indication, however, that the combined treatment will be superior in the years to come.

The three crops preceding this year showed that the maximum yield of asparagus shoots had been reached only with the maximum application of phosphoric acid. The asparagus plant is not at any stage a heavy consumer of phosphoric acid, and there had been applied a calculated surplus of the substance in the minimum amount. Nevertheless, there was evidently a need of more phosphoric acid, so the quantities applied this year were doubled and will be maintained at the higher rate in the years to come.

By another year, with the return to duty of Director Brooks, it will be possible to publish a detailed report of the fertilizer experiments.

Prof. J. B. Norton of the Bureau of Plant Industry, United States Department of Agriculture, has published the results of the experiments in breeding rust-resistant varieties of asparagus in Bulletin 263, Bureau of Plant Industry, entitled, "Methods used in breeding Asparagus for Rust Resistance." The bulletin covers the work up to the end of 1911, and shows notable progress in developing an immune variety. As a result of his field observations, Professor Norton, on page 59, makes the following important statement: "When rust was found in a commercial field, by following it up to the northwest, in the direction from which the prevailing winds come, a young bed, an old neglected bed, or wild asparagus was found in every case, and always with the remains of clustercup infections." He then suggests that wild plants should be dug up and burned, new beds should be planted where they will not affect cutting beds, and every shoot in the commercial field should be cut until the middle of June.

The cranberry substation at East Wareham has illustrated one of the uncertainties which confront the cranberry grower. The crop this year when picked was estimated to be a little over

200 barrels, while the crop of 1911 was 850 barrels. Last year's crop returned a gross income of $4,988.33; but this year's crop is not expected to return over $1,100.[1] This low yield was apparently due to a reaction or rest following the exceptionally heavy crop of 1911, because there was a relatively light bloom and no severe injury from insects or disease.

The expenditures at the substation have been grouped under three heads and do not include the salary of the superintendent. They were as follows: —

Expenses of maintenance,	$1,434 62
Permanent improvements,	551 09
Experimental,	1,243 25
Total,	$3,228 96

The work during the coming year will be somewhat curtailed to keep within the decreased income due to the scanty crop of this year. The bog is not expected to be self-sustaining as an experiment station, but as on any commercial bog the work will necessarily be contracted or expanded somewhat in proportion to the funds arising from its produce. The bog is in excellent condition and expenditures for maintenance and improvements can be lessened with no injury to it, while the experimental work can be continued without interruption.

The detailed report of Dr. H. J. Franklin for the past year will be found in another portion of this report.

The Agricultural Experiment Station has completed its thirtieth year. Its record of service can be found in the thousands of pages of its annual reports, bulletins and circulars, to which should be added the personal letters, by tens of thousands, that have been written for individual seekers after information.

During this period three decennial censuses have been taken by the State, viz., 1885, 1895 and 1905. The progress in Massachusetts agriculture shown by these censuses is interesting and indeed striking.

[1] The final sales in February, 1913, resulted in a return of $1,082.77 for 190 barrels of screened fruit.

Capital invested in agriculture in 1885 was $216,230,550, and in 1905 it had increased to $288,153,654, or a gain of 33 per cent. The value of agricultural products in 1885 was $47,756,000, and in 1905 it was $73,110,000, a gain of 53 per cent.

The experiment station has borne its part in this progressive agricultural movement and at slight cost to the State. Its average annual income during this period, including funds from the national treasury, has been less than one-fifth of a mill for each dollar invested in agriculture in 1885.

We believe it to be our duty at this time to point out to the people of Massachusetts new ways in which the experiment station can serve them in the years to come. Since the close of the year there have been prepared and brought together from all the departments detailed plans for projects which show new lines of investigation needed for the further advancement of agricultural interests. These projects may be grouped for convenience under the heads of crop production, crop protection, animal husbandry and agricultural economics.

Under crop production there have been proposed plans for systematic plant-breeding, which shall on the one hand determine the fundamental principles underlying the development of new varieties, and on the other hand shall result in the selection and introduction of new strains or varieties of staple farm and garden crops especially suited to our climate and soil. In fruit growing there is pointed out the need of more knowledge of cultural requirements in orcharding, owing to the differences in slope and surface of our hillsides, some of which are steep and some rolling, some rocky and some free from rocks. The adaptability of varieties needs consideration, and its study will require a knowledge of weather conditions and soil formation. A little less than one-fifth of the State has been surveyed by the Bureau of Soils of the United States Department of Agriculture, and it is desirable that this soil survey should be made complete, which must be done at the expense of the State. Judging from the surveys already made in this State and in adjacent States, there are probably between fifty and sixty distinct types of soils composing our

farm lands. As specialization in crops increases, it is important that the distribution of these types be known, because it will save many would-be growers of onions, tobacco, asparagus and similar specialties from disappointment and financial loss. New crops for florists need investigation and development, and a more efficient use of fertilizers should be worked out.

Crop protection involves continual study of predaceous insects, destructive fungi and bacteria, and also diseases produced by injudicious cultural methods, particularly in the forced crops under glass. First one insect and then another upsets nature's checks and balances owing to concentration of special crops, and the same thing is true of fungous growths. Instead of new lines of investigation this field requires more workers and more facilities.

In animal husbandry, the new projects may be considered as the expansion of present lines of investigation. The poultry-breeding experiment, which has already been mentioned, is planned to include the selection of a strain of high efficiency as utility fowls, and this project will require a progressive increase of house-room and labor, as the successive generations of fowls are produced. Efficiency in feeding animals is more necessary than ever before; therefore there is positive need for more extensive work in feeding cattle, pigs, horses and poultry than the station now can perform with its facilities. Two phases of the dairy industry, which have been but little studied from a scientific standpoint, are the production of market milk and the manufacture of ice cream. These phases are peculiar to our dense city population adjacent to our farms. Diseases of our domestic animals, particularly of poultry, are becoming of increasing importance due to the enlarged amounts of capital invested in single plants, and calls for diagnosis and advice are almost incessant. The need in all these lines is for more investigators, thoroughly trained specialists, and the demand, the country over, exceeds the supply; therefore the State that bids the highest gets their services.

Economics may not seem a subject belonging to an agricultural experiment station, but certain phases have always been studied. Inspection of fertilizers and feeding stuffs may prop-

erly be included under this head, because nothing is of greater importance to the user of capital than the certainty of receiving a full return for its expenditure. There is now needed a thorough investigation of methods of seed-testing and seed-separation as a foundation for a just law controlling the sale of agricultural seeds. Equally important as economic investigations are those of ice-storage of garden vegetables and the utilization of surplus fruit and vegetables in various manufactured products with home or community facilities.

Economical use of our agricultural resources and efficient application of capital to their development require more or less study of State conditions, viz., practices of successful farmers; methods followed in milk-production, potato-growing, corn-growing, fruit-growing and so forth; relation between success and location with respect to local markets, and location with respect to transportation facilities; and the relation between social surroundings and agricultural prosperity.

In planning these projects the station workers have had in mind increasing the service of this institution in behalf of the State for the ultimate development of every farm to a higher state of productivity and the assurance to the farmer of a greater prosperity.

To execute these projects will require double the present income of the experiment station, but the experiment station neither begs nor demands that this income be given it. It has presented the subject to the people and is ready to serve them, and will serve them to the utmost of its facilities.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE AGRICULTURIST.

E. F. GASKILL, ASSISTANT.

The duty of preparing the annual report of the agricultural department has fallen to the assistant agriculturist. Dr. Wm. P. Brooks, who has served as agriculturist of the experiment station since 1889, was forced to give up his duties last June because of ill health, and by vote of the trustees has been given leave of absence until September, 1913.

The work of the department for the past year was outlined almost entirely by Dr. Brooks and has followed the same general lines as in previous years, namely, experiments with fertilizers involving the use of 181 field plots, 13 orchard plots, 132 pots in our vegetation work and 147 inclosed plots, used largely to check results obtained in the field.

From year to year the department has made a careful study of many of the more promising varieties of potatoes, corn and soy beans; has investigated the possibilities of growing alfalfa in the State; and has co-operated with other departments of the station in carrying out many lines of investigation; but the main question under consideration has been the study of problems connected with soil fertility. Preferring to base conclusions on averages for a number of years, rather than on the results for one or two years, many of the fertilizer experiments have been continued from year to year. In view of this fact the report of the experimental work in this department, as in previous years, must in most instances be a report of progress. It is intended to present the work according to the plan generally followed, in order that the successive reports may furnish a complete record of each experiment.

The Comparison of Different Materials as a Source of Nitrogen.

Field A.

In this experiment there are eleven plots of one-tenth acre each, separated by division strips 4 feet in width. They have been fertilized each year according to the following plan: [1] —

Plot.	Source of Nitrogen.	Source of Potash.	Source of Phosphoric Acid.
0	Barnyard manure, [2]	– –	– –
1	Nitrate of soda,	Muriate of potash,	Dissolved bone-black.
2	Nitrate of soda,	Sulfate of potash-magnesia,	Dissolved bone-black.
3	Dried blood,	Muriate of potash,	Dissolved bone-black.
4	Nothing,	Sulfate of potash-magnesia,	Dissolved bone-black.
5	Sulfate of ammonia,	Sulfate of potash-magnesia,	Dissolved bone-black.
6	Sulfate of ammonia,	Muriate of potash,	Dissolved bone-black.
7	Nothing,	Muriate of potash,	Dissolved bone-black.
8	Sulfate of ammonia,	Muriate of potash,	Dissolved bone-black.
9	Nothing,	Muriate of potash,	Dissolved bone-black.
10	Dried blood,	Sulfate of potash-magnesia,	Dissolved bone-black.

The nitrogen, phosphoric acid and potash are applied in equal amounts to all plots except 4, 7 and 9. These receive phosphoric acid and potash but no nitrogen.

During the twenty-three years of the experiment the crops grown have been: 1890, oats; 1891, rye; 1892, soy beans; 1893, oats; 1894, soy beans; 1895, oats; 1896, soy beans; 1897, oats; 1898, oats; 1899, clover; 1900, potatoes; 1901, soy beans; 1902, potatoes; 1903, soy beans; 1904, potatoes; 1905, oats and peas; 1906, corn; 1907, clover; 1908, clover; 1909, clover;

[1] The materials are used at the following rates per acre: —

	Pounds.
Nitrate of soda,	290
Sulfate of ammonia,	225
Dried blood,	525
Muriate of potash,	250
Sulfate of potash,	485
Dissolved bone-black,	500
Manure,	8,000

[2] In addition, nitrate of soda, dissolved bone-black and sulfate of potash-magnesia have been applied to equalize the nitrogen, phosphoric acid and potash on plots 1-10.

1910, clover; 1911, corn followed by clover; and 1912, corn followed by clover.

The variety of corn grown this year was the same as last, — Rustler White Dent. It made a very satisfactory growth and was well matured by the 19th of September, on which date it was cut and stooked. The average yields for this year are shown in the following table: —

Average Yields per Acre, 1912.

Plot.	Hard Corn, Ears (Bushels).	Soft Corn, Ears (Bushels).	Stover (Pounds).
No-nitrogen (1, 7, 9),	67.86	1.61	5,116.70
Nitrate of soda (1, 2),	93.00	1.79	5,700.00
Dried blood (3, 10),	89.57	1.31	5,450.00
Sulfate of ammonia (5, 6, 8),	78.26	1.62	5,133.30
Manure (0),	80 00	1.29	5,000.00

On the basis of 100 for nitrate of soda, the relative standing of the different nitrogen plots and no-nitrogen plots, as measured by total yield during the past season, was as follows: —

	Per Cent.	
	Grain on Cob.	Stover.
Nitrate of soda,	100.00	100.00
Barnyard manure,	94.62	87 72
Dried blood,	96.31	95.61
Sulfate of ammonia,	84 15	90.06
No-nitrogen,	72.97	89.77

The relative standing of the different materials as indicated by total yield for the twenty-three years during which the experiment has continued is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	94.28
Dried blood,	92.95
Sulfate of ammonia,	87.38
No-nitrogen,	73.04

On the basis of increase as compared with the no-nitrogen plots the relative standing for the different fertilizers for the twenty-three years is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	78.78
Dried blood,	73.85
Sulfate of ammonia,	53.19

Nitrate of soda, as in previous years, shows the greatest average increase. The striking results obtained last year on the no-nitrogen plots are not so apparent this year. In 1911 the yield on the no-nitrogen plots was 95 per cent. of the average yield on all the different nitrogen plots; this year the no-nitrogen plots are represented by 73 per cent. In commenting upon the good showing made by the no-nitrogen plots last year, Dr. Brooks said: —

One of the most striking results of the past season was the relatively large yield produced on the no-nitrogen plots. It amounts to about 95 per cent. of the average yield on all the different plots which have received an application of nitrogen annually. This result, it will be readily understood, was no doubt due to the fact that clover for three years had preceded the corn crop of the past year. The figures emphasize in a most striking way the extent to which rotations including a legume may be made to take the place of the use of nitrogen fertilizers.

Muriate *v.* Sulfate of Potash.

Field B.

This is the twenty-first year of the experiment. The field consists of five pairs of plots, numbered from eleven to twenty. The odd plots (eleven, thirteen, etc.) have received annually an application of muriate of potash, while the even plots (twelve, fourteen, etc.) have received an application of high-grade sulfate of potash. In addition to the potash the plots have received annually an application of bone meal at the rate of 600 pounds per acre. During the early period of the experiment the potash salts were used in different amounts in different years. For the last twelve years an annual application of

250 pounds per acre has been applied to each plot. The object has been to supply annually the same amount of actual potash to each plot, and to study the effects of the continued use of these potash salts upon the same soil. The following table shows the crops grown this year and the rate of yield per acre for each: —

	Alfalfa (Pounds).	Asparagus (Pounds).	Blackberries (Pounds).	Rhubard. Stalks (Pounds).	Rhubard. Leaves (Pounds).	Raspberries (Pounds).	Strawberries (Pounds).	Mangel-wurzels. Roots (Pounds).	Mangel-wurzels. Tops (Pounds).
Muriate of potash,	5,837	5,734	4,027	17,647	19,669	939	4,403	40,608	6,486
Sulfate of potash,	7,331	4,348	4,609	25,343	28,302	1,300	5,087	32,897	4,276

Comparison of Different Potash Salts for Field Crops.

Field G.

The plan and object of this experiment is quoted from the nineteenth annual report of the experiment station: —

This experiment is designed to show the ultimate effect upon the soil, as well as the current effect upon the crops, of continuous use of different potash salts. We have under comparison kainit, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate and silicate.[1] The field includes forty plots, in five series of eight plots each. Each series includes a no-potash plot, as well as the seven potash plots which have been named. The experiment is therefore carried out each year in quintuplicate. The area of each plot is one-fortieth of an acre. The potash salts under comparison are used in quantities which will supply annually actual potash at the rate of 165 pounds per acre to each of the plots. All plots are equally manured, and liberally, with materials furnishing nitrogen and phosphoric acid.[2]

[1] Owing to our inability to obtain silicate of potash feldspar was substituted in 1908, and has since been used on these plots.

[2] The nitrogen and phosphoric acid are supplied by the following materials per acre: —

	Pounds.
Nitrate of soda,	250
Tankage,	270
Acid phosphate,	360

The crops grown on the field this year were as follows: —

Series I., plots 1–8, Rustler White Dent corn.
Series II., plots 9–16, Medium Yellow soy beans.
Series III., plots 17–24, Danish Ballhead cabbage.
Series IV., plots 25–32, Golden Tankard mangel-wurzels.
Series V., plots 33–40, Sweet German turnips.

The relative standing of the different potash salts for this year is shown in the following table: —

Yields per Acre.

Potash Salt.	Series I.			Series II.		Series III.	Series IV.		Series V.	
	Corn.			Soy Beans.			Mangel-Wurzels.		Turnips.	
	Hard Ears (Bushels).	Soft Ears (Bushels).	Stover (Pounds).	Beans (Bushels).	Straw (Pounds).	Cabbage (Pounds).	Roots (Pounds).	Tops (Pounds).	Roots (Pounds).	Tops (Pounds).
No potash,	75.43	-	4,200	24.48	2,920	37,800	31,880	13,720	27,000	13,600
Kainit,	83.43	-	5,600	24.14	2,800	41,000	36,880	16,120	38,520	12,880
High-grade sulfate,	81.14	-	5,280	27.59	3,320	41,400	32,400	12,200	37,120	12,280
Low-grade sulfate,	84.00	-	5,200	28.97	3,520	44,000	38,800	15,200	38,000	11,400
Muriate,	82.86	-	5,400	27.59	3,360	46,880	35,600	14,800	37,400	12,200
Nitrate,	80.57	.57	5,400	28.28	3,500	50,200	28,800	10,200	34,120	10,080
Carbonate,	47.43	1.14	5,480	19.31	2,420	47,400	37,000	12,000	33,400	11,200
Feldspar,	80.57	-	4,200	22.76	2,840	30,600	31,600	13,000	29,800	12,800

Comparison of Different Phosphates.

This is the sixteenth year of the experiment, the plan and object of which is quoted from the twenty-third annual report: —

> Ten of the leading materials which may be used as a source of phosphoric acid have been under comparison in one of our fields since 1897. The different materials are applied to the separate plots in such quantities as to furnish equal amounts of actual phosphoric acid to each. There are three check plots to which no phosphate whatever has been applied during the entire period of the experiment. All the plots receive annually equal and liberal quantities of materials supplying nitrogen and potash in highly available forms. The field has been used for a large variety of crops, the succession having been as follows: corn, cabbages, corn, oats and Hungarian grass (followed by rye plowed under), onions, onions, corn, mixed grass and clover three years, cabbages and soy beans and potatoes.

In view of the fact that the results of similar experiments (comparison of different materials as sources of phosphoric acid) in other States have not shown the marked differences between the ground rock phosphates and the more soluble phosphates that our results show, and in view of the fact that the humus content of the different soils is claimed by some authorities to be the cause of the differences in the showing of the rock phosphates, it has been our aim in the treatment of the field for the last few years to get as much humus into the soil as possible.

In 1911 the field was seeded in May with oats and alfalfa. Two crops were harvested, one in July and one in September. In 1912 the field was plowed and Japanese Buckwheat sown, which was plowed under in July. In August rye was sown, to be plowed under in the spring.

Average Corn Fertilizer compared with Fertilizer Richer in Potash.

North Corn Acre.

The two systems of fertilizing have been under comparison for twenty-two years. The object has been to determine whether or not the average corn fertilizer sold on our markets contains the right proportions of nitrogen, phosphoric acid and potash. The field consists of four plots of one-fourth acre each. Two of the plots — 1 and 3 — receive annually an application of a home-made mixture furnishing the different plant-food elements in the same proportions as in average corn fertilizer. The other two plots receive an application of a home-made mixture furnishing less phosphoric acid and more potash than the average corn fertilizer. The rotation is two years of grass and two years of corn. The crop this year was corn. The following table shows the relative standing of the two mixtures for this year: —

	Corn on the Cob.		Stover (Pounds).
	Hard Ears (Bushels).	Soft Ears (Bushels).	
Average corn fertilizer,	55.66	1.26	3,566
Fertilizer richer in potash,	61.69	1.37	4,090

The different materials were used on the plots at the following rates per acre: —

Fertilizers.	Plot 1 (Pounds).	Plot 2 (Pounds).	Plot 3 (Pounds).	Plot 4 (Pounds).
Nitrate of soda,	120	200	120	200
Dried blood,	120	–	120	–
Fish,	150	200	150	200
Acid phosphate,	1,092	200	1,092	200
Muriate of potash,	150	250	150	250
Slag,	–	–	–	400

The amount of plant food furnished an acre, its cost, and the profit realized by using the different mixtures are shown in the following table: —

Plots.	Amount (Pounds).	Nitrogen (Pounds).	Phosphoric Acid (Pounds).	Potash (Pounds).	Cost.[1]	Grain (Bushels).[2]	Stover (Pounds).	Value.[3]	Profit.[4]	Formula.
1 and 3, . .	1,632	38.35	196.49	77.68	$17 90	55.66	3,566	$44 97	$27 07	2.35-12.04-4.76
2 and 4, . .	1,050	42.93	104.01	129.63	15 41	61.69	4,090	50 34	34 93	4.09-9.91-12.34
Average corn fertilizer.[5]	1,700	41.65	165.07	76.84	28 27	-	-	-	-	- -

[1] Represents the actual cost of chemicals. To these should be added the cost of mixing, which will range from $1.50 to $2 per ton.

[2] The late spring and the unusually dry summer were not favorable for a good corn crop. In 1911 on these same plots the average yield of the four plots was over 85 bushels per acre.

[3] Based on the value of the crop at harvest time.

[4] Represents the difference between the cost of chemicals and the value of the crop. The labor question was not considered in this comparison because it was the same for all plots.

[5] The prices and formula for the corn fertilizer were obtained by taking an average of all the corn fertilizers reported in the 1911 fertilizer bulletin.

The composition of the corn fertilizers varies widely, and in taking an average of all corn fertilizers, reported in our fertilizer bulletin from year to year, we find considerable variation. The percentage of phosphoric acid is not as high at the present time as in former years.

The tables show that in order to supply about the same amounts of plant food per acre, it would be necessary to use 1,700 pounds of the average corn fertilizer. This at the average price per ton would cost over $28. It will be seen from the figures representing the cost of the different chemical mixtures, and the crops obtained, that it would be necessary to harvest a much larger crop on this fertilizer in order to insure a profit as large as that shown for the other fertilizers.

The prices used in these calculations were as follows: corn on the cob, 60 cents per bushel; stover in the field, $6.50 per ton; fertilizers at the current prices for 1912.

Manure alone compared with Manure and Sulfate of Potash.

South Corn Acre.

The two systems of manuring have been under comparison for twenty-two years. The field consists of four plots of one-fourth acre each. Two of the plots — 1 and 3 — receive an application of barnyard manure at the rate of 6 cords per acre, while the other two receive an application of manure at the rate of 4 cords per acre, and in addition an application of high-grade sulfate of potash at the rate of 160 pounds per acre. The crop grown this year was corn. The relative standing of the two systems for this year is shown in the following table: —

	Corn on the Cob.		Stover (Pounds).
	Hard Ears (Bushels).	Soft Ears (Bushels).	
Manure alone,	67.57	1.43	4,460
Manure and potash,	63.34	1.86	3,840

The following table gives the amount of fertilizer used per acre on each plot, its cost and the profit: —

Plot.	Fertilizer.	Cost.[1]	Grain (Bushels).[2]	Stover (Pounds).	Value.[3]	Profit.[4]
1,	6 cords manure,	$30 00	71.71	4,360	$57 20	$27 20
3,	6 cords manure,	30 00	63.43	4,560	52 88	22 72
2,	4 cords manure and 160 pounds high-grade sulfate.	24 00	60 00	3,800	48 35	24 35
4,	4 cords manure and 160 pounds high-grade sulfate.	24 00	66.63	3,880	52 59	28 59
1 and 3,	Average,	30 00	67.57	4,460	55 01	25 01
2 and 4,	Average,	24 00	63.34	3,840	50 48	26 48

[1] Represents the actual cost of the fertilizer used.

[2] The late spring and the unusually dry summer were not favorable for a good corn crop. In 1911 on these same plots the average yield of the four plots was over 86 bushels per acre.

[3] Based on the value of the crop at harvest time.

[4] Represents the difference between the cost of the material used and the value of the crop. The cost of spreading the manure was not considered because this item of expense would not be the same in very many cases.

Comparing the average of plots 1 and 3 with the average of plots 2 and 4 we find the materials cost more for 1 and 3; the amount of grain and stover produced is larger, but the profit is less.

The difference in favor of using the smaller amount of manure and potash is still more apparent when we consider that we have two cords less of manure to handle.

Comparison of Winter and Spring Application of Manure.

The details of the plan and object of this experiment may be found in the nineteenth annual report: —

> This experiment was planned to be continued through a series of years, with a view to throwing light upon the question as to the best method of handling farm manures. The field in use has an area of a little less than three acres, and slopes moderately to the west. It had been divided into five plots a number of years previous to the beginning of this experiment, for the comparison of different fertilizers. Each of these five plots was subdivided into two sub-plots. To one of the sub-plots in each of the five pairs the manure is applied during the winter, being spread upon the surface as it is hauled to the field; to the other sub-plot in each of the five pairs the manure as it is hauled is put into a large, compact heap. The manure used is carefully preserved, from well-fed dairy cows on four of the pairs of plots (1, 2, 3 and 4), and purchased stable manure from horses on one pair of plots (5). The experiment is so managed that all the manure is hauled for a single pair of plots at one time, usually during a single day, or at most within two days. To insure even quality of the manure on the two sub-plots, loads are placed alternately on the north half, where it is spread as hauled; and on the south half, where, as has been stated, it is put into a large heap. The land has usually been plowed late in the fall. The manure has usually been applied to the two sub-plots 1 early in the winter; to the sub-plots 2, 3 and 4, respectively, at intervals each about one month later than the preceding. The manure which is placed in the heaps remains there until it is time to prepare the soil for planting in the spring. It is then spread, and as soon as convenient the entire area, including both the winter and spring applications, is plowed.

Manure was omitted in 1912 and will not be applied as in previous years. Records will, however, be kept, the object now being to test the residual effect of the two systems of applying manure. There are five pairs of plots in the experi-

ment. The crop this year was mixed grass and clover hay. The average yields per acre in 1912 were: —

	Hay (Pounds).	Rowen (Pounds).
Winter application,	5,528.4	364.0
Spring application,	5,745.8	795.4

Top-dressing Permanent Mowings.

An outline of the plan and object of this experiment is quoted from the sixteenth annual report: —

In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about 9 acres. It is divided into three approximately equal plots. The plan is to apply to each plot, one year barnyard manure, the next year wood ashes, and the third year fine-ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds; and muriate of potash, 200 pounds per acre. The manure is always applied in the fall; ashes and the bone and potash in early spring.

The past year brought the fifth successive season unfavorable to hay production. The rain fall in May was slightly above the normal, but the following month was one of the driest Junes recorded since records have been kept here at the college.

The yield obtained this year on the different systems of manuring is shown in the following table: —

Fertilizers used.	Yield per Acre.		
	Hay (Pounds).	Rowen (Pounds).	Total (Pounds).
Barnyard manure,	3,610	1,359	4,969
Bone and potash,	3,655	1,164	4,819
Wood ashes,[1]	3,171	1,616	4,787

[1] Owing to the difficulty of securing good wood ashes a mixture of slag and muriate of potash, supplying the same amount of phosphoric acid and potash, was substituted this year.

The average yield for the entire period of the experiment (1893–1912, inclusive) for each system of manuring is shown in the following table: —

	Pounds.
Barnyard manure,	6,149
Bone and potash,	5,999
Wood ashes,[1]	5,636

The average yield for the entire area this year was 4,846 pounds, — a little better than the average yield for last year, but not equal to the average yield for the entire period of the experiment (1893–1912, inclusive) which is 5,959 pounds. The average yield for the period 1893–1911, inclusive, was 6,018 pounds.

[1] Owing to the difficulty of securing good wood ashes a mixture of slag and muriate of potash, supplying the same amount of phosphoric acid and potash, was substituted this year.

DEPARTMENT OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

REPORT OF THE BOTANIST.

G. E. STONE.

This department has the past year been engaged in the usual routine and research work, investigations being made of the new diseases which come to our attention and which are given a thorough study if they prove serious.

Mr. G. H. Chapman, research assistant, has been engaged on problems of a technical nature, and Mr. E. A. Larrabee's attention has been given mainly to the diagnosis of diseases and seed work. The office work has been carried on as usual by Miss J. V. Crocker, and Mr. R. G. Smith, who is at present assisting in the senior laboratory, performed some experiments in the summer with the chestnut bark disease. Messrs. Torrey, Larsen, Ellis, Lyon, Sullivan and Chase, undergraduate students, have given assistance in various ways, — in the greenhouse, with experiments, etc., and Mr. T. W. Nicolet has taken many of the photographs. A list of several problems which the department has been investigating follows.

A careful study is being made of some of the diseases of field and greenhouse crops. This includes an investigation of the conditions causing the diseases and experiments with methods for their control. Among those receiving special attention are some diseases of the apple, potato, cucumber, melon, lettuce, tomato and herbaceous plants and shade trees. In the last two years there has been present a serious blight on greenhouse cucumbers which has in some instances caused a total failure of the cucumber crop in this section, and some study has

been made of this disease. For five years experiments have been carried on relative to the control of potato scab, and some of the results of this work will be contained in this report. These experiments will be continued.

Some further lines of work are given in brief: —

Investigations relating to improved methods of seed germination and separation.

Experiments on the control of weeds in lawns, etc.

Investigations relating to the injurious effects of oil sprays on fruit trees.

Investigations relating to the effects on shade trees of chemical substances applied to roadbeds.

Investigations relating to the effects of different fumigants on greenhouse crops which are subject to variations in light intensity and moisture.

Investigations relating to the effects of various spraying solutions on plants exposed to variations in light intensity, etc.

Investigations relating to the burning of the foliage of greenhouse plants by fumigants as related to the condition of the stomata.

A study of the weed situation in cranberry bogs.

Testing of a large variety of chemical substances to ascertain their fungicidal value.

Investigations relating to overfeeding and malnutrition in greenhouse plants, a trouble which is becoming more common in greenhouses.

Investigations relating to the relationship between various light intensities and the effects of different spraying solutions, and the maximum carbon assimilation in such crops as potatoes, grapes, etc.

Investigations relating to the fixation of nitrogen by the electrical stimulation of micro-organisms.

Experiments with methods of keeping roots from drain tiles, — a continuation of those already published.

A study of spraying machinery and new types of nozzles.

Experiments with a new type of soil sterilizer.

Investigations relating to the mosaic disease as occurring on different plants; nearly completed.

Investigations relating to light in greenhouses; practically completed.

Experiments with methods of treating tree cavities.

Experiments with the effects of varying percentages of soil, moisture and air on the germination of seeds.

Experiments with the effects of ozone on seed germination and various plant activities.

These investigations have been carried on in some cases for some time, and several of them would properly come under the heading, "Investigations of the effects of meteorological conditions on the diseases and the development of plants in general," which we are studying under the "Adams fund."

DISEASES MORE OR LESS COMMON DURING THE YEAR.

G. E. STONE.

Like the year before, this season has been characterized by severe drought in the summer months, with some rain in the fall, although the rainfall in August, September and October was less than the normal. In November, however, it exceeded the normal. In May, June and July the drought and heat were such as to cause considerable defoliation of trees and unevenness in corn fields, although this last was in some cases due to poor seed which was affected by frost the year before.

The unusually large onion crop ripened poorly in some fields, and in the Connecticut valley many hundreds of bushels had to be left on the ground owing to non-maturity. Potatoes were of excellent quality, with less than the usual amount of early blight, and the rot was not very noticeable. Apple trees showed some winter killing of the twigs and roots as the result of the preceding severe winter, with some sunscald and a few cases of what appears to be injury from spraying with oil. The leaves of those trees in particular which were not sprayed were affected to an unusual degree with scab (*Fusicladium*) and leaf spots (*Sphæropsis*). The scab was more or less common on the fruit in the fall and was accompanied in almost every case by pink mold (*Cephalothecium*), but no serious injury occurred. Apple rust (*Gymnosporangium*), which has been more or less common the last three or four years, was seen occasionally on the leaves, and in a few instances affected the fruit. Storage burns were common in some localities, due possibly to defective storage conditions, and in other cases to the rather poor ripening or hardening up of the fruit. Apple fruit rots were unusually abundant late in the fall, being caused, apparently, by the abnormal ripening of the fruit. As usual, there was very little rot (*Glœospo-*

rium) on the tree, but it occurred later at the time of harvesting. The black rot (*Sphæropsis*) usually constitutes 80 or 90 per cent. of our fruit rots, but this year the bitter rot (*Glœosporium*) prevailed and *Sphæropsis* was quite scarce, and for this reason there was more rotting of the fruit on the tree than is usually seen here. The brown rot (*Sclerotinia*) and blue mold rot (*Pencillium*) were quite common, as was the fruit spot (*Cylindrosporium*), which affected many varieties of apples.

Crown gall (*Pseudomonas*) is not so prevalent now as a few years ago, as greater care is being taken in buying apple stock. Peach leaf-curl (*Exoascus*) was unusually severe in the spring, especially on unsprayed trees, and much curling of the foliage was caused by aphis. Peach and plum rots (*Sclerotinia*) were not common, and other than the winter killing of the fruit buds the trees made good growth and were quite free from disease. There was some pear blight (*Bacillus*) and sooty mold, which grows in the secretions of aphis. Rusts (*Gymnosporangium*) in general have been more common the past four years, but they were less conspicuous this season than last. Among these may be mentioned quince, bean, apple, Vinca, rose and ash rust. The quince rust continues to be more or less of a pest. The white pine blister rust (*Cronartium*), introduced a few years ago, is now receiving attention from the nursery inspector. The European currant rust, one stage of the pine blister rust, has recently made its appearance, being first observed on the black currant in Essex County, the only location known in this State at the present time.

Among other more or less common diseases noticed during the year are the maple leaf spot (*Rhytisma*), pea mildew (*Erysiphe*), several sweet pea troubles of a miscellaneous character, the leaf spot of the cherry (*Cylindrosporium*), asparagus rust (*Puccinia*), oat smut (*Ustilago*), hollyhock rust (*Puccinia*), potato scab (*Oospora*), corn smut (*Ustilago*), black rot of grape (*Guignardia*), bacterial wilt of cucumbers (*Bacillus*), currant leaf spot (*Septoria*), frost injury to asparagus, blossom end rot of tomatoes and scab (*Cylindrosporium*), oak and sycamore leaf blight (*Glœosporium*), black spot of rose (*Actinonema*), rose mildew (*Sphærotheca*), leaf spot of mignonette (*Cercospora*),

melon blight (*Alternaria*), celery blight (*Cercospora*), apple canker (*Sphæropsis* and *Nectria*), and winter killing of raspberries and roses, sycamore twigs, privet and others.

The unusually severe infection from aphis caused a loss of foliage to many trees. A peculiar mottling of chestnut leaves which were thickly covered with honey-dew was noticed, and examinations of the leaf tissue revealed a partial plasmolysis of the cells, accompanied by considerable defoliation; but after showers, which would wash off the honey-dew, the defoliation would cease.

The general deterioration of shade trees which has been noticeable for the last six or seven years has been even more pronounced the last two years. The trees showing the most deterioration are the elm, maple, white and black ash, butternut and Norway spruce; and the sycamore showed winter killing of the twigs last season, with a Glœosporium infection of the foliage. The roots of the elm, maple and oak are constantly dying back, and for the last two years maples have been showing what is termed "staghead," supposed to be due to a diminution of water in the soil in some cases, and in others winter killing of the roots is no doubt a contributing factor. Many thousands of maples have been so affected in the northeastern United States. Last winter was one of the worst on record for depth of freezing, and vegetation in general was in poor condition, owing to the drought, to enter upon even a mild winter. The freezing of gas and water pipes was of so frequent occurrence as to cause an unprecedented number of leaks. In one city with about 50 miles of pipes, over 200 leaks were recorded, the loss of gas amounting to about 33 per cent., and in some cases sections of the supply had to be cut off. Thus it is not surprising that winter injury of various kinds occurred, although to what extent vegetation has suffered we cannot tell as yet.

A NEW RUST.

G. E. STONE.

Currant Rust, White Pine Blister Rust.

In previous reports we have mentioned an epidemic of rusts which have been unusually severe the past few years on the apple, bean, quince and ash, and last year we noted a new rust on Vinca. A new form has lately made its appearance on the black currant. The white pine blister rust has also been with us for several years, affecting most largely young nursery stock, although it is occasionally found on white pines of fairly good size. On September 28 some specimens of currant rust were sent in from a large estate in Essex County, this being the first outbreak recorded in Massachusetts to our knowledge. At practically the same time Dr. G. P. Clinton observed a similar outbreak in Connecticut, and Prof. F. C. Stewart, of the Geneva Experiment Station, noted an outbreak in New York.

The rust in this State is confined, so far as we know at the present time, to one block of 200 currant plants of the Black Champion variety. The plants were two-year-olds, purchased last spring from a New York nursery, and practically all in this block were infested except about twenty-five or thirty in the southwestern corner of the block. About a quarter of a mile south of the diseased currants was a small block of old black currants, but they showed no signs of Cronartium. About the same distance east was a magnificent stand of eight-year-old pines, but rigid examination failed to reveal any signs of blister rust infection; neither was any infection found on the near-by block of red currants.

The following description of the currant rust and white pine blister rust, which are different stages of the same rust, was prepared at my request by Mr. E. A. Larrabee, from various literature.

The white pine (*Pinus Strobus*) blister rust (*Peridermium Strobi*) has only been known in Germany for the last thirty or forty years. In this country it has been discovered within the last few years. In 1906 Dr. F. C. Stewart of the Geneva station in New York found the disease on the grounds there, but prompt and radical treatment is believed to have completely eradicated it. Again, in 1909, it was found in New York State on a shipment of three-year-old white pine seedlings from Germany.

This fungus has two well-known forms which have in former years been described as two distinct species, — one appearing on the currant and gooseberry (*Ribes*), and the other on the white pine. The stage found on the Ribes bushes was discovered and named about fifty years ago by Dietrich, while the stage on the pine was discovered and named by Klebahn in 1887. Since this time, however, by careful and extensive inoculation experiments, it has been conclusively proved that *Peridermium Strobi* on the pine, and *Cronartium ribicola* on Ribes are not two distinct species of fungi, but are different stages of the same organism.

Unfortunately, the presence of this fungus is not apparent at or before planting time. It is particularly noticeable in this country probably during the month of May. It then covers the trunks of young pines of four or five years and over, as well as the trunks and branches of older pine trees, with bright yellow blisters in which are contained the æcidiospores. These æcidiospores appear as a dark yellow powder and cannot germinate unless they fall on the leaves of currants or gooseberries (*Ribes*). On these leaves, however, they develop, send germ tubes into the leaf tissue, and there form a heavy matting of mycelium. Along about the middle of June there are formed on the under side of the leaves of these Ribes plants bright yellow deposits (uredospores) which spread the disease from leaf to leaf on these plants. These uredospores continue to spread throughout the Ribes during the entire season in which young leaves are formed. In the summer, too, still another reproduction cell is found in the shape of yellow-brown strings or sacs, of about the thickness of a hair, on the under side of the leaves of the Ribes bushes, and these are known as teleuto-

spores. On the surface of these so-called strings are deposited tiny cells known as sporidia. These sporidia will germinate only on the bark of young shoots of the white pine.

The so-called sporidia are produced and carried about by the wind at the very season when the young pine shoots have begun to develop and are in a condition to be readily infected. When the small sporidia germinate they send their germ tubes into the tender bark of the white pine, and there the mycelium again forms a heavy matting. This tissue lives for many years in the branches, and occasions considerable swelling of the shoots, by which the disease may be detected in the fall and winter, when there are no yellow deposits on the bark. These swellings often do not show on the white pine for perhaps a year or more. It is probably several years after infection before these dark yellow spore blisters are formed, but when they once appear they often reappear every spring for a number of years on the same swellings. Their appearance is preceded by the formation of very small dot-like heaps of spores which are called spermogonia. These spermogonia contain sweet-tasting, sticky spores, so-called spermatia, about which nothing is known.

It will be seen from the preceding that this disease cannot spread from one pine to another. It must first go from pine to Ribes (in May or June) and from Ribes back to pine (in August or September). In the trunks of pine trees the fungus is perennial, but on Ribes it affects only the leaves and cannot live over winter.

While it would appear from this description of the rust that an alternation of hosts is necessary in the case of currant rust, some American pathologists would question this, and observations made by some investigators on the rust in this country seem to indicate that the rust may be able to propagate indefinitely on the currant without the intervention of the pine.

At the request of Professor Stewart we are therefore conducting experiments to determine whether reinfection of currants can occur without the intervention of the pine. These are now being carried on in our greenhouse, together with some other experiments relating to the control of the disease; and work along the same lines is being done by Dr. Clinton in Connecticut.

This disease on the currant can undoubtedly be eradicated by some method of spraying, but if not, it may be necessary to destroy all the black currants in the State, as they are not of great economic importance. The white pine blister rust is being carefully looked after by Dr. H. T. Fernald, State Inspector of Nurseries.

EFFECTS OF ILLUMINATING GAS ON VEGETATION.

G. E. STONE.

It is well known that escaping illuminating gas in the soil has an injurious effect on vegetation, and occasionally kills trees. In States where records [1] are required of the amount of gas manufactured, and that unaccounted for, the loss is found to amount to considerable in some cases, but this does not always mean that all unaccounted-for gas escapes in the soil or air, since these measurements are dependent on different meter readings. The meters may run too slow or too fast, requiring a great deal of care to warrant any degree of accuracy. Moreover, gas varies greatly with temperature, and even 6 or 8 per cent. of unaccounted-for gas is not necessarily all leakage.

There are several kinds of gas used for lighting and heating, *i.e.,* water gas, coal gas, gasoline gas, acetylene gas and others, but their effects on the plant are quite similar, and they are all very poisonous to vegetation. Even the same kind of gas varies to quite an extent, as the process of manufacture is not always the same. This difference in composition is often very slight, but to any one who has had experience in diagnosing trees killed by gas it is discernible; for example, the gas manufactured by one corporation will produce different effects on a tree from that manufactured by another; yet gas from the same plant differs very little as a rule.

Illuminating gas is very poisonous to vegetation. The poisonous properties are largely confined to the numerous products which are absorbed by the soil moisture in small quantities, taken up by the roots and translocated through the tissue.

[1] Consult Ann. Repts. of Inspector of Gas Meters and Illuminating Gas, Mass. Public Documents, No. 55; Ann. Repts. of Board of Gas and Elec. Light Comm., Mass. Pub. Documents, No. 35.

These substances are to be found in the tissue, although, as already pointed out, the reactions are not quite the same in different places nor on different species of trees. Trees poisoned by illuminating gas usually show some characteristic post-mortem symptoms, but many of these symptoms may be found in trees dying from other causes. More or less rapid deterioration and increased brittleness of the wood is a quite characteristic symptom, however.

In summer the first effects of gas poisoning may be seen in the foliage. The leaves turn yellow and in some cases drop off, while the leaves of other trees fall while still remaining green, and in still other cases the trees do not become defoliated but the leaves turn a reddish brown and die. The upper part of the tree, being far away from the source of water supply, usually shows the effects first. All this occurs before there is any evidence of abnormal tissue above ground. The water contents of the soil containing the poisonous principles of gas pass up through the roots and stems, and later the wood and zone constituting the living portion of the trunk become abnormal. The first symptoms appear in the characteristic dryness of the cambium and other tissues outside the wood, this being the first indication of the approaching death of the tissue. Later these tissues, — cambium, phloem and cortex, — turn brown and disintegration follows. These abnormal conditions first take place in the roots, which are the first to absorb the poison, but later, as absorption and translocation proceed, the poisonous constituents may be detected in the wood, etc., at the base of the tree. It not infrequently happens that the tissue at the base of the tree is dead, while that in the trunk a few feet above is alive. But this condition does not endure, for sooner or later the whole tree becomes involved. When the underlying tissues, cortex, phloem, etc., die, the bark changes color, gradually growing darker, the tissue tensions are destroyed, and the physical properties of the bark are greatly changed. Soon various species of fungi, such as *Polystictus, Schizophyllum* and others, find a foothold on the bark and borers and other insects attack the dead tissue. Even bacteria and molds, like *Penicillium,* become active and hasten the process of disintegration, the smaller twigs becoming dry and brittle, and the ends are often broken

off. The upper limbs usually lose their bark first, and eventually the larger limbs present the same appearance. Disintegration may become so rapid that in one and a half to three years most of the larger branches will break off, and soon nothing but a portion of the trunk and a few stubs remain.

All these conditions refer merely to the way in which a tree succumbs to gas poisoning, and do not necessarily constitute reliable symptoms of this type of injury, as these symptoms may be found in trees dying from other causes. The tissue furnishes the most reliable symptoms for diagnosis. The writer has for years been examining thousands of trees killed by gas, and has taken exhaustive notes on every symptom shown by trees dying from various causes, and from the first it was found necessary to make a thorough examination of the tissue to warrant any degree of accuracy in the diagnosis. From these notes may be had much interesting data on the relative importance of various symptoms. Since some of the poisonous constituents of illuminating gas are absorbed by the roots and are circulated to a certain extent through the tissue of the wood, it becomes necessary to note these substances and learn to detect their presence, either by chemical means or from direct observations and experience.

As already stated, no two species of trees present precisely the same symptoms, much variation occurring from location, seasons, etc. A certain species, for example, examined in the fall, will show slightly different symptoms from those given by a spring examination, and this is true of trees poisoned by gas from different manufacturing plants, due undoubtedly to the fact that there is considerable difference in the gas manufactured by different concerns. The different chemical constituents of the soil in remote localities might to a certain extent be held responsible for the variations in the reaction of gas on the tissues, but this is probably not very important, since these variations are likely to occur even in a single town supplied from one source, and as a rule the symptoms in trees injured by gas from a single manufacturing plant are alike. From tables giving the results of gas analysis from various corporations we find that there is considerable difference in the composition of gas, and furthermore, that gas from a single corporation

is likely to vary from day to day to some extent. This variation is not only found in the different percentages of gas constituents but in the other products.

The principal features in the tissues from which diagnosis may be made are odor and color, although it is possible by the use of chemicals to obtain reactions and to detect certain products in the tissue of trees killed by gas. There are different odors associated with the wood of trees which die from various causes, and it is necessary to become familiar with these to be able to differentiate them. Molds and other micro-organisms acting on the sap of trees dying from various causes often cause decomposition, with certain resultant odors which occur in a great variety of trees. But always in trees killed by gas may be found peculiar characteristic odors difficult to describe, even if the tissue most seriously affected is found. This tissue is usually at the base of the tree or in the larger roots near where the tissue has absorbed the most poison, and it is more easily recognized after a tree has been dead for a few weeks or months. The odor is more prominent in moist than in dry trees. It can be detected in the tissues of the bark as well as of the wood.

Sometimes this odoriferous wood is found deeper in the sapwood than at other points, and can be recognized in the stumps of trees freshly cut, but in old stumps where decay has set in it is not always discernible. In such cases some part of the root system, if dug up, is likely to give a characteristic odor except when the wood has become too dry and a more or less advanced stage of decay has set in. As previously stated, the odors are difficult to describe, as they are often associated with the products of decomposition. Moreover, the odors of one tree are entirely different from those of another, so one has to become familiar with the characteristics of each species of tree which he is diagnosing. The natural odor of the maple is quite different from that of the elm, horsechestnut or red oak, and their products of decomposition differ also. Nevertheless, the characteristic odor given to the tissue by the products of illuminating gas can be differentiated quite easily and accurately by any one familiar with them. Sometimes these odors are found in a considerable part of the tissue of the trunk, but more often they are

confined to some special part of the tree or root. They are more pronounced by far at the base of the tree than above, and in the top are rarely to be noticed.

We know of no remedies which can be applied to trees already poisoned by gas, since the injury occurs below the surface of the ground, and the effects on the tree are seldom noticeable until the poisoning is more or less pronounced. If the leakage of gas could be discovered quickly and the leak repaired, the effects on the roots might be prevented, but this is rarely the case. In some instances where only one root has been affected, and the poison has not reached the trunk of the tree, amputation of the root is used to prevent further harm, and we have seen cases where this has proved effective. There are many cases where trees have not suffered from gas poisoning although located near large leaks, because in the installation of curbings many of the larger roots were destroyed which grew over the roadbed where the gas pipes were laid.

When the soil is charged with gas, excavating and aerating are beneficial, and in the case of severe leakage it is well to leave the trench open for a few days, if possible. On the other hand, boring holes in the soil and filling with water is of absolutely no value. It is generally believed that if young trees are planted near others which have died from gas poisoning they will not live, but this is true only in part. If the soil is thoroughly saturated with gas, bad results may follow, but if young trees are planted in fresh loam and the old soil aerated there is little likelihood of the tree dying. It is possible, but perhaps at the present time not practical in all instances, to prevent injury to trees and asphyxiation to people in houses from gas leaks, and undoubtedly in the future better methods of distributing gas will be employed.

Summary.

The symptoms of gas poisoning are best obtained from a careful examination of the wood at the base of the tree or the roots. This can be done when the poisonous principles have reached a certain point in their ascent. There are many symptoms accompanying gas poisoning such as a yellowing of the leaves, drop-

ping off, peeling of the bark, presence of certain fungi, etc., but they are of no value in themselves, as these symptoms may accompany other causes of death.

The Effect of Illuminating Gas on Foliage.

Gas from soil leakage seldom escapes into the atmosphere sufficiently to cause direct injury to foliage, although trees are sometimes injured near gas-manufacturing plants, where there is usually a strong odor of gas. Atmospheric gases of all kinds are quickly dispersed, especially when there is any circulation of air; yet under certain conditions they cause injury to plants, as is well known. The leakage of illuminating gas from soil pipes is seldom sufficient in quantity or prolonged enough for it to injure the foliage of trees and shrubs.

The trees in large cities often suffer greatly from atmospheric gases, of which the most injurious are those arising from coal combustion. The escape of illuminating gas into sewers and conduits is not uncommon. If an untrapped greenhouse drainage system connects with a sewer containing gas, the gas is likely to find its way into the greenhouse and injure the plants, and we have known of large greenhouses losing many plants in this way, the gas escaping into the greenhouse for long periods in such minute quantities as to be scarcely perceptible to the sense of smell. Last winter, when the upheaval of the ground from frost did great damage to gas and water pipes, the gas from a leak near our greenhouse found its way to a drain tile leading to the house some distance from the source of leakage, defoliating a large number of our plants in a few hours. A rose plant which was in perfect condition the night before was found the next morning with most of its leaves turned yellow, and 50 or more per cent. of them had fallen. The plants most severely affected were roses, geraniums and abutilon, but ivy, Eucalyptus, India rubber plants, willow, Kenilworth ivy, papyrus, tobacco, tomato and Sedum were also injured. The ferns, mosses and liverworts, which were nearest the gas inlet, were scarcely touched. After being defoliated, the geraniums and abutilon produced numerous small leaves, and the leaves on the variegated abutilon came in entirely green.

Hartig[1] mentions that Camellias, azaleas and ivy are very sensitive to escaping gas, the least sensitive being palms and Dracænas. It would appear that the higher plants are more susceptible to gas than the lower ones. This might be explained on the assumption that the lower plants, being descendants of very old types which in past ages may have been adapted to different atmospheric conditions, possibly inherit a wider range of adaptability, with consequently less liability to injury.

Effects of Illuminating Gas on Carolina Poplars.

Our attention has been called at different times by Mr. James Walker, of the Newark Shade Tree Commission, Newark, N. J., to a peculiar effect which poisoning from illuminating gas has on Carolina poplars (*Populus deltoides* Marsh).[2] This tree is used extensively for shade in New Jersey, but has recently come into disrepute owing to the havoc which its vigorous root system raises with sewers. Some of these characteristic toxic effects consist in a splitting of the bark and swelling and bulging of the tissue near the lesions, and later a slimy, mucilaginous mass exudes from the cracks.

This last season we examined a Carolina poplar which displayed, in addition to the usual symptoms of gas poisoning, this peculiar swelling and cracking of the bark, and some of the tissue was gathered for histological examination. The tree in question was 7 or 8 inches in diameter near the base, and at the time of observation, in common with most trees affected by gas poisoning, had no leaves. The bark, cortex, etc., on the trunk towards the source of absorption showed three or four vertical cracks or lesions ½ to 2½ feet long. The bark on the sides of these cracks was bulged out considerably, and examination showed a thick layer of soft, parenchymous tissue extending to the wood and apparently derived from the cambium zone. This tissue at the time of observation was perfectly white and fresh in appearance, was easily broken and apparently as delicate as the tissue of an apple. Later the tissue turned brown and disintegrated and became slimy in appear-

[1] R. Hartig, "The Diseases of Trees."

[2] We have heard the opinion expressed at different times that Carolina poplars are immune to gas poisoning, but there is no foundation for this statement.

ance. This breaking down of the tissue takes place in the more advanced stages of disintegration and, according to Mr. Walker, this broken-down mucilaginous substance exudes from the cracks. Specimens of the bark and tissue showed this soft layer, which was thicker directly under the cracks, where the tension was less, to be anywhere from ½ to 1½ inches thick. Microscopic examinations showed the fresh tissue to be composed entirely of thin-walled parenchyma cells.

In the illustration, 1 shows an enlarged cross section of a piece of normal bark; 2, a cross section of the bark near one of the cracks; 3, a cross section of bark and wood and the abnormal parenchymous growth; and 4, a cross section of the normal bark, including some of the wood. In 2 and 3 the abnormal growth is shown at *e*. In 3, which is an enlarged section, the nature of the tissue is readily seen, as well as its origin from the cambium *f*. In 5 is shown a diagrammatic cross section of tree, with lesions.

This peculiar cracking characteristic of Carolina poplars poisoned by gas has never been observed by us in other species, although like effects have been noticed in willow cuttings growing in water charged with gas, in which case we have often noticed a splitting of the bark and slight swelling, followed by the formation of a mucilaginous mass under the bark. The bark of most trees poisoned by illuminating gas remains intact until it becomes very dry and brittle, and then it cracks, curls up and eventually falls off. There is, however, no disposition in other trees, so far as noticed, for the tissue to become mucilaginous. In some cases of poisoning of coniferous trees the bark may become ruptured and a copious flow of pitch follow. This tissue is apparently what is termed by Hartig "wound cambium," and we have never seen it forming on poplars as the result of ordinary mechanical wounds.

During the past season we have noticed a number of cracks on small poplars (*Populus tremuloides*) apparently resulting from frost injury. But in this case there was no abnormal development of the cambium.[1]

When banding substances are applied to Carolina poplars

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[1] The injection of poisons into tissue is said to cause a rupturing of the tissue owing to changes in the turgescence of the cells.

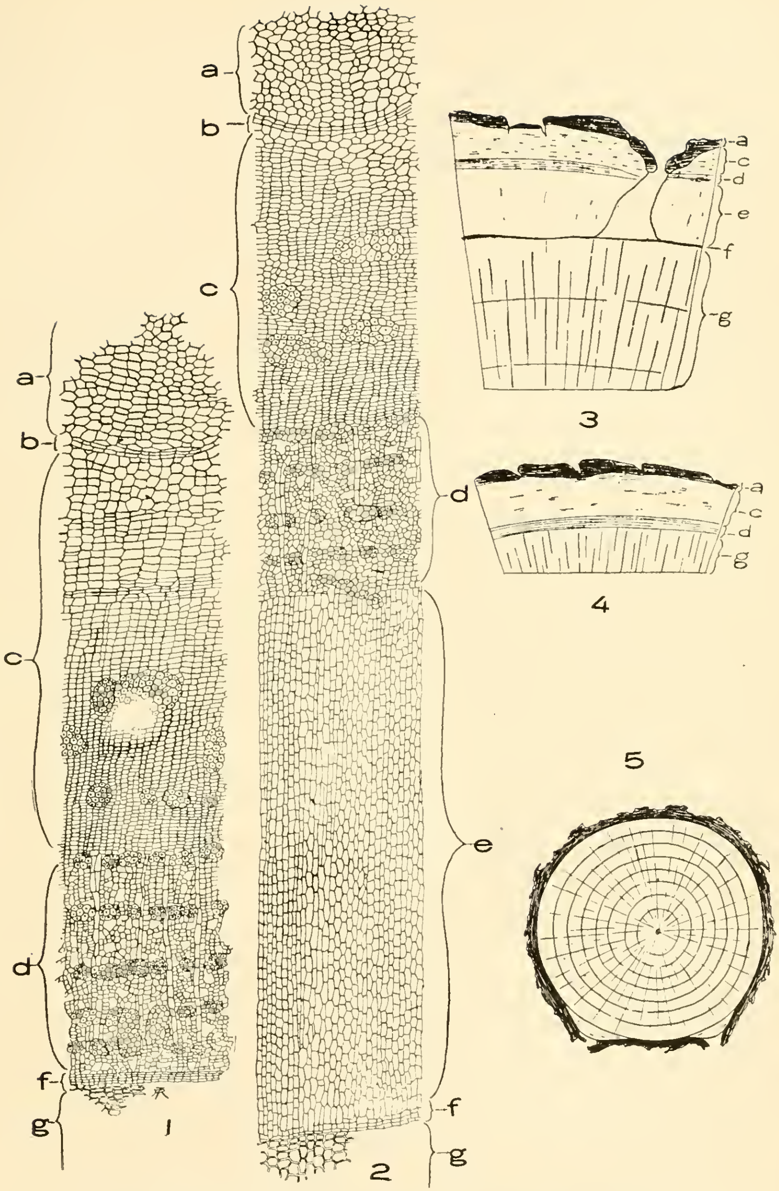

FIG. 1.—Showing cross section of Carolina poplar (*Populus deltoides* Marsh). 1, Cross section of normal stem, enlarged; 2, same, showing abnormal growth; 3, naked-eye view of same; 4, section of a normal stem; 5, cross section of trunk of tree showing the splitting of the bark; *a*, bark; *b*, cork cambium; *c*, cortex; *d*, phloem; *e*, abnormal parenchyma; *f*, cambium; *g*, wood or xylem.

and other trees to trap insects, injury often results to the tissue, with swellings and distortion where the substances come in contact with the bark. We have seen many trees affected in this way in the eastern part of the State, where much use has been made of banding substances for the extermination of the gypsy moth. Their effect is more pronounced on Carolina poplars than on other trees, and it is not improbable that this cracking and abnormal formation under the bark results from decreased turgescence of the cell and destruction of the outer tissue, thus relieving the tension on the inner tissue and causing the cambium to divide. With the release of the pressure outwards, it is natural for this tissue to extend in this direction, thus rupturing the outer bark. The absorption of the gas may have killed the tissue exterior to the cambium layer before the cambium was affected. In this way, the tension of the outer tissue being diminished, a stimulation of the cambium cells results.

The poisonous constituents of gas have a direct stimulating effect on the cells during the incipient stage of poisoning, as observed in the case of willow cuttings, etc.; but in this instance it would appear that the excessive development of the cambium was caused by the diminished tension of the cortical tissue.

Stimulating Effects of Illuminating Gas on Willow Cuttings.

For many years we have been studying the effects of different gases on the functions of plants, and during this time we have made many experiments relative to the effects of water charged with illuminating gas on the development of willow cuttings. It is well known that there are many chemical substances which stimulate plants. Even the most violent poisons, if administered in certain dosages, will greatly increase plant activities; for instance, ether is well known to cause latent buds to blossom, and some use is made of it by commercial florists.

Illuminating gas is a deadly poison both to the foliage and root systems of plants; but when administered under certain conditions is a great stimulant. Latent willow cuttings grown in water charged with illuminating gas for a few moments every day or two showed a greatly increased development, pro-

ducing foliage several days earlier than plants grown in water not charged with gas.

The results of experiments with latent willow cuttings grown under these conditions are shown in Table I. The cuttings were grown in glass jars containing about 2 litres of water which was charged at different periods, as shown in the following table: —

TABLE I. — *Showing Stimulating Effects of Illuminating Gas on Willow Cuttings grown in Water charged with Gas.*

[In all experiments except No. 1, 8 normal and 8 treated cuttings were used in each series.]

Experiment.		First Appearance of Leaves and Shoots.	Gain in Development (Days).	Water charged with Gas for a Brief Period.
1	Normal,	August 19	9	Every second day.
	Treated,	August 10		
2	Normal,	December 10	8	Every second day.
	Treated,	December 2		
3	Normal,	January 4	8	Every second day.
	Treated,	December 27		
4	Normal,	December 29	6	Every second day.
	Treated,	December 23		
5	Normal,	February 4	11	Every second day.
	Treated,	January 24		
	Treated,	January 22	9	Every fourth day.
	Treated,	January 24	11	Every sixth day.
6	Normal,	February 20	5	Every second day.
	Treated,	February 15		
7	Normal,	March 25	6	Every seventh day.
	Treated,	March 19		
8	Normal,	April 24	5	Every second day.
	Treated,	April 19		
	Treated,	April 20	4	Every fourth day.
9	Normal,	July 18	4	Every second day.
	Treated,	July 14		

The data given in this table show that the willow cuttings contained in the charged jars developed new shoots and foliage from four to eleven days earlier than those grown in jars containing the ordinary uncharged tapwater. They also show that

FIG. 2. — Showing willow cuttings growing in water; those to the right, in ordinary water, those to the left, in water charged with gas.

FIG. 3. — Showing development of lenticels on willow cuttings growing in water. Figure to the right growing in ordinary water; to the left, in water charged with gas.

there is practically no difference in the development of the cuttings, whether the jars were charged with the gas every second day, every fourth day, etc. (Fig. 2).

The duration of these experiments was from one to two months. In some instances the plants showed more or less advanced symptoms of gas poisoning at the close of the experiment, and the oftener the water was charged with gas the quicker the symptoms appeared and the more pronounced the poisoning. The same stimulating effects were shown on the roots as on the stems and leaves.

Table II. gives the results with both shoots and roots as determined by the average length, as follows: —

TABLE II. — *Showing the Stimulating Effects of Illuminating Gas on Willow Cuttings grown in Water charged with Gas.*

[Eight treated and 8 untreated cuttings used in each series. All measurements given in centimeters.]

Experiment.		Average Length of —		Percentage Gain in Average Length of —	
		Shoots.	Roots.	Shoots.	Roots.
1	Normal,	2.50	2.00	-	-
	Charged every second day,	6.00	8.00	140	300
2	Normal,	1.50	2.00	-	-
	Charged every second day,	5.00	6.00	233	200
3	Normal,	1.00	3.00	-	-
	Charged every second day,	4.00	6 00	300	100

In this table the average length of stems and roots is given, together with the per cent. gain in average length of each. Only three experiments are given. It will be noticed that there was considerable gain in the average length of roots and shoots of the cuttings grown in gas-charged water.

Another similar series of experiments is shown in Table III., as follows: —

TABLE III. — *Showing the Stimulating Effects of Illuminating Gas on Willow Cuttings grown in Water charged with Gas.*

[Eight untreated and 8 treated cuttings used in each series. All measurements in centimeters.]

	Experiment.	Total Number of Times charged.	Total Number of — Shoots.	Total Number of — Roots.	Total Length of — Shoots.	Total Length of — Roots.	Average Length of — Shoots.	Average Length of — Roots.	Percentage Gain in Average Length of — Shoots.	Percentage Gain in Average Length of — Roots.
1	Normal,	-	8	9	2.00	11.10	.25	1.20	-	-
	Charged every second day,	15	53	82	164.00	294.00	3.09	3.58	1,096.00	198.38
2	Normal,	-	35	40	178.50	196.00	5 10	4.90	-	-
	Charged every second day,	34	36	156	212.40	113.88	5.90	7.30	15.68	48.98
3	Normal,	-	30	42	125.60	111.10	4.18	2.64	-	-
	Charged every second day,	24	24	142	161.30	703.90	6.72	4.95	36.89	87.50
	Charged every fourth day,	12	32	161	178.60	1,000.10	5.58	6.21	33.49	135.22
	Charged every sixth day,	6	30	151	204.70	753.20	6.82	4.98	63.15	88.67
4	Normal,	-	32	39	140.90	104.40	4.40	2.67	-	-
	Charged every second day,	24	13	127	162.20	677.90	12.47	5.33	183.40	99.90
	Charged every fourth day,	12	38	131	344.50	932.90	9.07	7.12	106.10	166.60
	Charged every sixth day,	8	30	145	295.10	776.40	9.83	5.35	125.60	100.40

Summary of Table III.

	Number of Plants.	Average Number of —		Average Length in Centimeters of —		Per Cent. Gain in Average Length of —	
		Shoots.	Roots.	Shoots.	Roots.	Shoots.	Roots.
Normal,	32	26	32	111.75	105.90	-	-
Treated,	64	32	138	215.35	656.53	92.7	519.9

This series of experiments was conducted like the preceding, except that measurements were made of the total number and length of shoots and roots, which was greater in the gas-charged water. The average number of shoots in the treated water was 32, and of those in the normal or untreated, 26, while of the roots, the average for the treated water was 138 and for the untreated, 32. The stems and roots in the charged water greatly exceeded in development those in the untreated water, and appeared much earlier.

From these data it will be seen that the effects of gas in increasing the number of roots are quite noticeable. Similar results are shown with the total length of shoots and roots; for instance, the cuttings growing in the charged water grew longer roots and shoots than those in the untreated water. It will also be noticed that the total length of roots is relatively greater than the total length of shoots. The average total length of the normal, untreated shoots was 111.75 centimeters, of the treated shoots, 215.35 centimeters. The average length of the normal roots was 105.90 centimeters, and that of the treated, 656.35 centimeters. The average gain of the treated over the untreated shoots was 92.7 per cent., and that of the treated over the untreated roots was 519.9 per cent. The percentage gained in average length of shoots and roots in each experiment ranges from 15 to over 1,000 per cent. in favor of those grown in gas-charged water.

In summarizing the results of these experiments it may be said that there was little difference in the average number of shoots in the normal and treated, but the average number of roots in the treated shoots exceeded those of the normal; furthermore, the total and average length of roots and shoots in

the treated water greatly exceeded that in the untreated. While only a slight difference was shown in the number of shoots in the normal and treated willow cuttings, the latter showed a greater development. The increased development of the shoots and foliage was correlated with the greater root development. We regard the increased root development of the treated willow cuttings as a direct response to oxygen supply. The roots of cuttings growing in the charged water were invariably more slender than those in the untreated, and were also characterized by an early appearance of a profuse growth of secondary roots.

Effects of Illuminating Gas on Lenticels.

The lenticels or breathing pores of the willow cuttings grown in water charged with gas showed a marked difference in development. They always show a greater growth in water, but the development of the parts submerged in water charged with gas was exceptional. Many years ago Nobbe [1] observed when conducting water culture experiments with potatoes that the submerged tubers developed unusually large lenticels.

This stimulation of the lenticels was one of the most conspicuous reactions we observed in our experiments with willow cuttings, and appears to be a general response to a demand for oxygen. (Fig. 3). The gas in the treated water had practically the same asphyxiating effect on the plant as a decreased supply of oxygen, the demand for oxygen being increased and the plant responding by a greater growth of the lenticels.

The response on the part of the roots of the willow cuttings to the stimulating effects of gas appears to be the same type of reaction, *i.e.*, practically amounting to a decreased oxygen supply. Observations on plants grown under a diminished atmospheric pressure have given somewhat similar results to those shown by the willow cuttings; that is, they grow more rapidly than those under normal conditions. This is not, however, the effect of the diminished pressure alone, but is due to a diminution of the partial pressure of oxygen. Wieler and Jaccard [2] have demonstrated that the optimum growth of plants does not

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[1] Landwirtsch. Versuchstation, Vol. IV., 1864, p. 60.

[2] Schimper's Plant Geography, p. 69.

correspond to the normal atmospheric pressure. According to Jaccard, a decrease in the pressure of oxygen gives rise to an accelerated growth and more profuse branching of the axis and roots, together with an increase in the size of the leaves. The water containing gas is taken up in small quantities by the roots and translocated to the stem and leaves, and since plants possess considerable power of accommodation they can do this for quite long periods without injury.

Plants, like animals, respond to stimuli arising from various causes, and while plants may not respond as quickly as animals, their sensitiveness is in many instances more acute. Specific stimuli give rise to definite responses, and the nature of the response usually corresponds with some immediate need of the organism. The presence of water charged with gas in the plant tissues stimulates the demand for oxygen, which is manifested in a greater root development and leaf surface.

Man and animals respond characteristically when subjected to a decreased oxygen supply such as is caused by unusual exertion like mountain climbing, running, etc. Dogs open their mouths, run out their tongues and breathe more rapidly when excited, and this is in reality a response to the demand for more air or oxygen. In the same way, the increased size of lenticels is a direct response to the demand for oxygen, although in the case of both animals and plants it is purely reflex and involuntary.

Illuminating Gas as a Factor in Forcing the Development of Plants.

The stimulating effects of gas-charged water on willow cuttings led us to experiment with illuminating gas in other ways, therefore a number of experiments were made to determine the effects of atmosphere charged with the gas on the development of dormant willow cuttings. Ether and other substances have been used to stimulate plants in a dormant condition, and we wished to learn whether gas would have the same effect.

The willow cuttings were placed under sealed bell jars in vessels of water and subjected to an atmosphere of illuminating gas for twenty-four, forty-eight, seventy-two, ninety-six and one hundred and twenty hours, respectively. A number of cuttings

were used in each test, and after being treated for these different periods they were removed from the bell jars and placed under greenhouse conditions to await the results of treatment. When these cuttings were compared with untreated or normal plants, as they were in all cases, a slight acceleration was found in the development of all plants subject to gas for twenty-four, forty-eight and seventy-two hours, although the gain was not marked.

THE INFLUENCE OF VARIOUS LIGHT INTENSITIES AND SOIL MOISTURE ON THE GROWTH OF CUCUMBERS, AND THEIR SUSCEPTIBILITY TO BURNING FROM HYDROCYANIC ACID GAS.

G. E. STONE.

The influence of light on photosynthesis, structure and development of plants is well known to plant physiologists, but is too little appreciated by growers of crops, whether under glass or in the field. It is also well known that plants grown in the dark are pale and slender, with undeveloped leaves, and they quickly wilt and die when exposed to different temperatures and light conditions. The variations in light intensity in the greenhouse or in the field, such as occur in periods of cloudy weather, affect crops greatly. There are many features connected with greenhouse construction, such as inferior or dirty glass, angle of the roof, heavy shadow-casting frames and others which also play an important part in plant development. Certain light-requiring crops grown under the inferior light conditions of November and December develop abnormally, and often suffer greatly from wilts in the spring when the light is more intense. The plants possess light-colored, thin leaves, elongated and slender internodes and leaf petioles, and, in fact, are in a state of partial etiolation.

Light inhibits growth and has a remarkable effect on the texture of plant tissue. While it has a great deal to do with the non-ripening and ripening of wood, moisture, temperature and other factors also enter in.

The successful growing of lettuce under glass requires exceptional skill, as much attention has to be given to the influence of light, moisture and other factors on the crop to prevent what

is termed "topburn," a certain texture being required to do this. Even a difference of a few degrees in the night temperature exerts marked influence on the texture of the tissue. Lettuce plants which are grown under a night temperature of 45° F. differ greatly from those grown at a temperature of 50° F., the structure of the plant being modified for each degree of increase or decrease in the temperature. With the lower night temperature there is less likelihood of burning than with the higher. If a night temperature of 50° F. is maintained during cloudy weather, and on a following bright, sunshiny day the temperature is allowed to reach 75 or 80° F., topburn is likely to occur. On the other hand, a night temperature of 40° F., during cloudy periods followed by a relatively high day temperature, is not likely to produce any burning.

Light has a marked accelerating effect on transpiration, as the stomata of the leaves open in bright sunshine, and the loss of water from the foliage under these conditions is large. In the blossom end rot of tomatoes, a disease caused primarily by heavy drainage of water from the fruit during its development, we have noted a difference of 35 per cent. in the amount of rot, caused by the shading of the tomato plants by other plants, reducing the transpiration.

Practical growers who have had occasion to fumigate greenhouses to destroy aphis, white fly and thrips have observed that their plants will burn slightly at one time and at other times not; for instance, hydrocyanic acid gas, tobacco leaves or concentrated solutions of tobacco, and other fumigants sometimes cause injury to plants and at other times produce no burning. This is also true of spraying mixtures, whether used in the greenhouse or field.

The experiments given here are designed to show some of the causes underlying burning from fumigation, and were made by Mr. F. L. Thomas during his course as a graduate student. The plants selected were cucumbers, as they are susceptible to burning from various causes, and are also affected greatly by variations in light intensity. The plants were grown under five cloth screens, ranging in grade from mosquito netting to rather finely woven cotton material, each covering a space 2 feet wide, 6 feet long and 2 feet high on a long bench in the greenhouse.

The normal plants were grown in the same bench but were not screened, and the light conditions were the same as those in the greenhouse. The house is new and the light excellent, — only about 18 per cent. less than out of doors. The relative light intensity under the various conditions varied sufficiently to cause considerable difference in the development of the plants. These differences were determined by chemical methods accurate enough to warrant the average relative light conditions being obtained, but not adapted to measure the absolute light intensity.

In the following tables are given the results of experiments with the effects of different light intensities on the growth of cucumber plants and their susceptibility to burning from hydrocyanic acid gas. In each experiment 6 groups of plants were used, No. 5 being grown under normal greenhouse conditions and the others under varying light intensities.

Since two of the screened compartments gave practically the same light intensities, and the results obtained from the plants in these sections were similar, they were averaged together and appear in the table under No. 2. The plants were grown in 7-inch pots and entirely under the screens. The moisture content of the soil was kept fairly uniform in each series. After the plants had reached a certain degree of development they were placed in a tight glass case containing about 30 cubic feet, and each series was fumigated at the same time under similar conditions as regards exposure and the amount of hydrocyanic acid gas. The plants were all fumigated with .007 grams of cyanide per cubic foot, a strength commonly used in greenhouse work, and known as formula [1] 1–2–3, — one part cyanide, two parts sulfuric acid and three parts water. After undergoing this treatment for forty minutes to one hour the plants were removed from the case and the results noted.

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[1] Bul. 123, Mass. Agr. Exp. Station, 1903.

Table I. — *Showing Effects of Different Light Intensities on the Growth of Cucumber Plants and their Susceptibility to Burning by Fumigation with Hydrocyanic Acid Gas.*

Experiment I. — *Duration, May 2 to June 6.*

[Measurements in centimeters.]

	Number.				
	1.	2.	3.	4.	5 N.
Relative light intensity (per cent.),	24 4	26.60	48.10	74.00	100.0
Average height of plants,	13 0	20.10	11.00	17.00	16.0
Average diameter of stem,	.4	.57	.45	.65	.8
Average length of internodes,	5.0	5.90	4.20	4.00	3.7
Leaf: —					
Average length,	7 5	8.60	5.20	9.90	8.7
Average width,	6.5	9.C0	6 20	9.20	10.5
Length by width,	48.7	77.10	32.20	91 00	91.3

Note. — No. 1, all leaves killed; No. 2, leaves burned, few killed; Nos. 3, 4 and 5 N, traces of burning.

Experiment II. — *Duration, May 8 to June 13, 1911.*

[Measurements in centimeters.]

	Number.				
	1.	2.	3.	4.	5 N.
Relative light intensity (per cent.),	24 4	26.C0	48.10	74 0	100.0
Average height of plants,	30 5	28.30	2 10	27.2	16.0
Average diameter of stem,	.5	.62	.55	.7	.8
Average length of internodes,	8.2	6.60	6.60	4 7	3.5
Leaf: —					
Average length,	9 0	8.10	6.00	5 5	6.2
Average width,	10 5	11.50	9 00	9 5	12.5
Length by width,	94.5	93.70	54.00	52.2	77.5

Note. — No. 1, burned; some leaves killed; Nos. 2 and 3, some burning; Nos. 4 and 5 N slight burning.

Experiment III. — *Duration, May 22 to June 24, 1911.*

[Measurements in centimeters.]

	Number.				
	1.	2.	3.	4.	5 N.
Relative light intensity (per cent.),	24 40	26 C0	48 1	74 00	100 00
Average height of plants,	23.50	23 30	20 0	15.70	14.70
Average diameter of stem,	.42	.55	.6	.65	.75
Average length of internodes,	8.70	8.60	7.1	4.45	4.85
Leaf: —					
Average length,	8.50	9.90	9.7	8.70	8.20
Average width,	8.20	10.30	10.5	11.20	10.70
Length by width,	69.70	100.30	101.8	97.40	87.70

Note. — No. 1, burned; No. 2, burned; No. 3, slight burning; Nos. 4 and 5 N, no burning.

Summary Table.

[Measurements in centimeters.]

	Number.				
	1.	2.	3.	4.	5 N.
Relative light intensity (per cent.),	24.40	26.60	48.10	74 00	100.00
Average height of plants,	22.30	23.30	17.30	19.90	15 50
Average diameter of stem,	.44	.53	.53	.66	.78
Average length of internodes,	7.30	7.00	5.90	4 30	4.00
Length by width of leaves,	70.90	90.30	62.60	80.20	85.50

It will be noticed that the difference in development of the plants in the preceding experiments arises from the fact that they were growing under varying light intensities. Many physiologists, particularly Wiesner, have studied the effects of light intensities on the conformation of plants, and it is necessary, therefore, to mention only in a general way the modifications caused by light. Altogether too few plants were used to eliminate the differences arising from individual variation; nevertheless, the summary table shows a more or less uniform variation in the development of the plants due to different light intensities.

No. 5N, which was growing in the greenhouse, was taken as a normal for growth comparison. The light conditions for this plant were taken as 100 per cent., and represent those characteristic of our latitude at the time the experiments were made, minus an average loss of about 18 per cent. from the greenhouse glass. No. 4, which was screened, received only 74 per cent.; No. 3, 48 per cent.; No. 2, 26 per cent. and No. 1, 24 per cent. These percentages, of course, are purely relative, and are based on the assumption that the plants under normal conditions in the greenhouse received 100 per cent. of light. It will be observed that most of the injury occurred to those plants growing under the poorest light conditions, and the least where the light conditions were best. In considering the results as given in the summary table, which are more reliable than those in the other tables, as they represent averages, much difference is shown in the development. The greatest average height of the

plants and length of internodes were found in those series where the light was less, while, on the other hand, the shortest internodes and greatest diameter of the stems occurred in those plants which received the most light; but the average length and width of leaf were variable, as shown in the table. The data giving average length and width of the leaves were obtained by multiplying the width by the length, and represent fairly well the size of the leaf.

It will be noted that the plants growing where the light was excluded had the largest leaves. The leaf development, of course, varies according to the season, and is also affected by light exposure, methods of pruning, etc., and greenhouse cucumbers usually have much larger leaves than field cucumbers. Whatever the optimum photosynthetic requirements for cucumbers may be, or what relationship exists between the size of the leaves and optimum photosynthesis, we do not know; but the production of larger leaves under certain light intensities is apparently a response to a demand for greater carbon assimilation.

To summarize the results of these experiments: burning from hydrocyanic acid gas is more extensive on plants grown under poor light conditions than where the light is good, showing that weak tissue, such as is produced by inferior light, is more susceptible to burning from fumigation.

Influence of Varying Percentages of Moisture on the Development of Cucumbers and their Susceptibility to Burning from Hydrocyanic Acid Gas.

That the percentage of moisture in soil has an important bearing on crop production, exerting a modifying influence on growth and development, is well understood and usually taken into consideration by experimentalists. Plants will make greater growth in a relatively moist soil, although there is an optimum moisture content of the soil for most plants. Besides growing more rapidly, a plant in a moist soil develops a different type of tissue, which is usually less resistant to various injurious agencies than the dry soil plant. Two or 3 per cent. more water in a plant than what might be considered the nor-

mal renders it more susceptible to winter killing, topburn and even fungous infection. Lettuce, for instance, will burn more quickly when the tissue contains more than the usual amount of water, and mildew and rusts are more common on plants with a relatively high water content.

The object of our experiments in growing plants in different percentages of soil moisture was to determine what influence soil moisture had on the development of the plant, with special reference to susceptibility to burning from hydrocyanic acid gas. We used cucumber plants, as before, growing them in small, galvanized iron pots holding about 1½ kilograms of soil. The soil was the greenhouse type, containing considerable organic matter, with a water-retaining capacity of 47 per cent. The total water-retaining capacity of the soil in these experiments was regarded as 100 per cent. The various soils in the pots were maintained at 10, 20, 50 per cent., etc., of the total water-retaining capacity.

After reaching a certain degree of development under greenhouse conditions the plants were placed in a tight case, as in the preceding series of experiments, and treated with .007 grams of cyanide per cubic foot, as before. After treatment the plants were taken out of the case and left for further observations.

TABLE II. — *Showing the Effects of Different Percentages of Soil Moisture on the Growth of Cucumber Plants and their Susceptibility to Burning from the Use of Hydrocyanic Acid Gas.*

EXPERIMENT I. — *Duration, June 5 to June 20.*

[Measurements in centimeters.]

	Number.				
	1.	2.	3.	4.	5.
Per cent. moisture,	10.000	25.0	40.00	55.00	70.00
Average height,	3.300	6.5	8.00	10.50	2.70
Average length of internodes,	2.000	4.7	6.00	4.00	2.00
Average length of petioles,	.750	2.0	3.75	3.66	.75
Average diameter of stem,	.275	.4	.45	.50	.30
Average length by average width of leaf,	1.000	3.0	4.50	4.75	2.00

NOTE. — Nos. 1, 2 and 3, no burning; Nos. 4 and 5, burned.

EXPERIMENT II. — *Duration, March 12 to April 11, 1912.*

[Measurements in centimeters.]

	Number.					
	1.	2.	3.	4.	5.	6.
Per cent. moisture,	10.00	15.0	20.0	50.0	60.0	70.0
Average height,	6.50	8.0	11.0	14.0	18.0	21.5
Average length of internodes,	4.50	4.5	6.0	7.0	8.0	8.0
Average length of petioles,	1.50	1.5	2.5	3.0	4.0	3.0
Average diameter of stem,	.30	.3	.4	.4	.6	.5
Average length by average width of leaf.	6.25	52.0	59.0	185.2	300.0	276.0

NOTE. — Nos. 1 and 2, no burning; No. 3, slight burning; Nos. 4, 5 and 6, nearly all leaves burned.

EXPERIMENT III. — *Duration, March 12 to April 11, 1912.*

[Measurements in centimeters.]

	Number.					
	1.	2.	3.	4.	5.	6.
Per cent. moisture,	10.00	15.0	20.0	50.0	60.0	70.0
Average height,	6.00	7.0	9.5	12.0	17.0	21.0
Average length of internodes,	4.00	4.5	4.5	4.0	7.0	8.5
Average length of petioles,	1.20	2.0	2.0	3.5	4.0	3.5
Average diameter of stem,	.30	.3	.4	.5	.5	.5
Average length by average width of leaf.	6.25	27.0	76.0	140.0	150.0	320.0

NOTE. — Nos. 1 and 2, no burning; No. 3, slight burning; Nos. 4, 5 and 6, nearly all leaves burned.

Summary Table, Experiments II, and III.

[Measurements in Centimeters.]

	Number.					
	1.	2.	3.	4.	5.	6.
Per cent. moisture,	10.00	15.0	20.0	50.00	60.00	70.0
Average height,	6.20	7.5	10.2	13.00	17.50	21.2
Average length of internodes,	4.20	4.5	5.2	5.50	7.50	8.2
Average length of petioles,	1.30	1.7	2.2	3.20	4.00	3.2
Average diameter of stem,	.30	.3	.4	.45	.55	.5
Average length by average width of leaf.	6.25	39.5	67.5	162.50	225.00	285.0

FIG. 1.—Showing cucumber plants growing in different percentages of moisture. No. 1, in 10 per cent.; No. 2, in 15 per cent.; No. 3, in 20 per cent.; No. 4, in 50 per cent.; No. 5, in 60 per cent.; No. 6, in 70 per cent. of the total moisture contents of the soil.

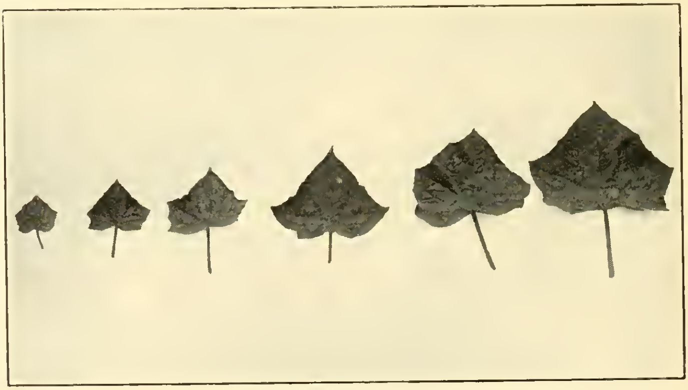

FIG. 2.—Showing leaves taken from cucumber plants grown in different percentages of moisture, corresponding to those shown in Fig. 1.

In the preceding table it is shown that different percentages of soil moisture exert a marked influence on the development of the plants, and their susceptibility to burning from fumigation. It will be noticed (see Summary Table) that the average height of the plants was greater and the leaves larger in the pots containing the largest percentage of water. (*Cf.* Figs. 1 and 2.) Also the diameter of the stems and length of leaf petioles and internodes was greater in the plants growing in a higher percentage of soil moisture, although in the case of the plants growing in pots containing 70 per cent. of water there was too much moisture for the best development.

In Experiment I. the water was supplied largely to the surface of the soil, and in II. and III., below the surface. The plants growing in soil containing over 50 per cent. of moisture burned most severely, while those in soil containing less were not affected nearly so much, showing the extent of injury to be proportionate to the amount of soil moisture. Examination of some of the leaves under a microscope showed much variation in the number of stomata. The upper leaf surface of a cucumber plant grown under normal moisture conditions had 27 stomata to the square millimeter, while that of a plant grown in soil containing 10 per cent. of moisture had only 11.

Those who have used cyanide to any extent in greenhouses are well aware that it has a rather narrow range of safety, and that burning will occur at one time and not at another when the conditions are apparently identical. Most fumigating is done after dark, and it is usually customary to first wet down the greenhouse, on the idea that if the house is well filled with moisture, fumigation is more effective, especially when tobacco is used; and by fumigating after dark less injury is supposed to result from burning of the foliage. This latter notion is based on the assumption that the leaf stomata close in darkness, and therefore less gas is absorbed by the foliage, and burning is not likely to occur.

There are numerous factors associated with the burning of foliage by fumigation which are not well understood. The effect of sunlight and atmospheric moisture, etc., on the burning of tomatoes and cucumbers has been studied by Dr. H. T. Fer-

nald, Mr. W. V. Tower and Dr. C. H. Hooker [1] in the entomological greenhouse. They found that sunlight, cloudy weather, moonlight, drops of water remaining on the foliage and too high a moisture content of the atmosphere were all conducive to burning, and that less burning occurred on cloudy nights or clear nights without moonlight. The best results were obtained by fumigating on clear, starlight nights, with little or no moonlight, or on dry, cloudy nights with a temperature range of 55° to 65° F.

Some observations recently made by Mr. S. S. Crossman in our laboratory show among other things that the stomata or breathing pores, as always believed, close quite rapidly when subjected to darkness, and open in the sunlight, and that various gases result in a closing of the stomata. Mr. Crossman did not have an opportunity to finish his work, but Mr. G. H. Chapman, research assistant, intends to continue it the coming year. If the burning of leaves is caused by gases entering the stomata, and if the stomata are closed by gases, then it is not apparent why foliage should burn more severely in the daytime than at night. Some experiments made a few years ago in our laboratory by Mr. H. M. Jennison, on the effects of various gases on transpiration, showed that when plants are subjected to gases transpiration decreases rapidly, but in most of these experiments, as well as in some of our own with illuminating gas, there occurs a secondary rise in the transpiration curve shortly after the first drop. From these experiments it would appear that various gases cause a marked retardation in transpiration at first, followed by a brief but marked acceleration, after which a general retardation in transpiration follows.[2] It is possible that the stomata of the gas-treated plants may open again shortly after being closed by the gas, and finally close again. Observations on this point, however, are not sufficient for us to draw any definite conclusions.

The effect of burning on foliage is varied, in some cases merely the margin of the leaves being burned. Sometimes burning takes the form of numerous small spots on the leaf,

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[1] Twenty-first Ann. Rept., Mass. Agr. Exp. Station, 1909, p. 73; Twenty-second Ann. Rept., Mass. Agr. Exp. Station, 1910, p. 214.

[2] Jumelle found (see Schneider, Bot. Gaz., Vol. XVIII,. p. 57) that sulfuric ether increased transpiration in light and retarded it in darkness, while Schneider found that by this treatment transpiration was retarded under all conditions.

and this would appear to prove that burning takes place through the stomata. In other cases burning appears in more or less large, irregular spots scattered over the leaf, which was the case in these experiments. The margins of the leaves of cucumbers at times become injured from excessive transpiration, the thin and apparently less developed tissue farthest from the water supply being most susceptible. From the nature of many of the burnings resulting from fumigants in these experiments, it does not appear that the condition of the stomata has anything to do with the susceptibility to burning, but is due rather to the condition of the tissue. The experiments bear out this conclusion, it being found that the plants grown under conditions calculated to develop a less resistant tissue are the ones which burn most severely, and that any condition which has a tendency to develop immature tissue favors injury from fumigants. Other factors, such as the continued use of too high temperatures, and probably in some cases certain fertilizers and stimulated growth from various causes such as pruning, growing in sterilized soil, electrical stimulation, etc., bring about the formation of tissue susceptible to burning; and while burning may be associated in some cases with the condition of the stomata and with the process of photosynthesis, the development of the cuticle and texture of the tissue in general plays an important part. In plants growing under more or less dense shade Mr. Thomas noticed, as anticipated, that the epidermis was more poorly developed than that of those plants growing under better light conditions, and that the hairs on the leaves of the well-lighted plants were much larger and more numerous than those on the leaves of the poorly lighted plants. Ecologically, hairs are for the purpose of modifying the effect of light and transpiration, but whether their presence has any bearing on susceptibility to burning was not learned. The difference in the number of stomata on the upper surface of the leaves of plants growing under varying moisture conditions is evidently an adaptation to transpiration.

As regards the various factors associated with burning, such as light, atmospheric moisture, temperature, etc., we are in need of more experimental evidence relating to the specific rôle

which each factor may play. The experiments of Dr. Fernald and Messrs. Tower and Hooker, already referred to, were not all made at the same time, which unfortunately introduces a varying factor. They observed that drops of water on the foliage caused burning. Burning often results from fungicides remaining in a liquid form for even a brief period on the foliage. Water apparently absorbs hydrocyanic acid gas, since we have found that trout, which are very susceptible to this gas, located in an aquarium outside the compartments in greenhouses being fumigated with this gas, are killed, although goldfish do not seem to be affected.

While these experiments do not throw light on all the factors involved in susceptibility to burning, they do demonstrate that burning by fumigation with hydrocyanic acid gas is induced by a difference in the development of the tissue, whether brought about by inferior light conditions or excessive moisture in the soil, the more poorly developed tissue being more susceptible to burning. Further experiments are being conducted in our laboratory to throw more light on the influence of other factors on burning.

The most important practical feature brought out by these experiments is that fumigation should be done only when the plants are in the right condition. Any expert gardener can determine at a glance whether his plants are developing normally, and under glass he can control the environment to a large extent. Care should be used in fumigating during periods of cloudy weather, as under these conditions the same amount of resistant tissue is not developed. Low night and day temperatures, as well as a decrease in the soil moisture, counteract this to some extent, but the presence of light is the most important factor in developing resistant tissue. Fumigation will cause less injury following bright than cloudy weather, and should not be done for two or three days after a cloudy period, so that the plants will have a chance to harden up their tissue. Plants growing in relatively dry soils are affected to a less degree by fumigation than those in moist soils. The same care and attention should be given to prevent injury from fumigation that is used by lettuce growers to prevent topburn.

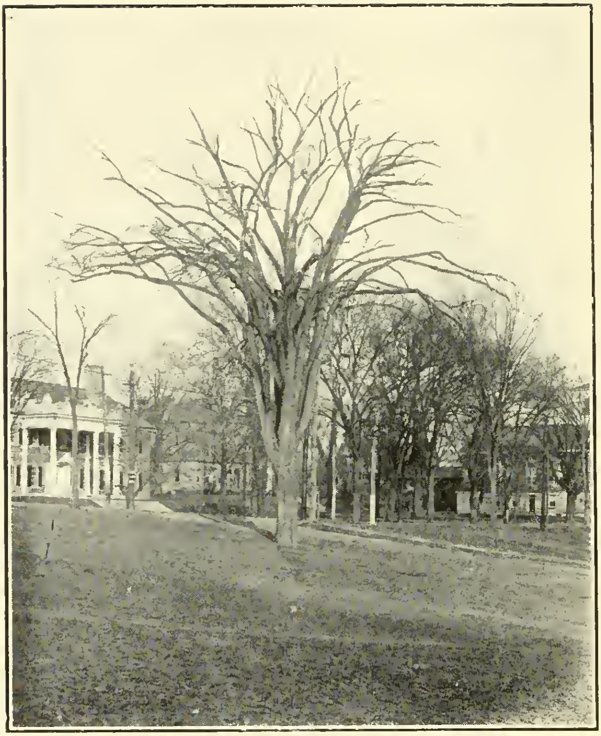

FIG. 3.—Showing elm tree slowly dying, with staghead effect. Note dead, stubby branches at the top.

FIG. 1.—Showing red maple, alive, but with inferior foliage at the top.

FIG. 2.—Showing maple with staghead effect.

SHADE-TREE TROUBLES.

G. E. STONE.

Staghead and Root Injury.

Many trees since the year 1904 have been showing a characteristic trouble called "staghead." This was particularly noticeable in different degrees of severity on the red maple (*Acer rubrum*) during the summer of 1904, caused by winter killing of roots, etc. In some cases the injury took the form of a scant production of foliage at the top, while in others most of the foliage at the top would not grow to more than one-fourth its natural size (Fig. 1); and in still other cases, and by far the most common, the top of the tree died outright (Fig. 2). In the cases where the foliage was merely thin the trees recovered the following season and have remained in a normal condition since. In others, the foliage at the top would become continually more scant and more limbs affected, until eventually the whole tree would die. Owing to a defective root system a very large number of maples were affected in this way.

During the past two years a large number of trees in the northeastern part of the United States have shown this staghead effect. The trouble appears to have come from the root system, but whether due to winter injury or to the extreme drought which has been common the last five or six years, or to both, is not known at the present time. There are many varieties of shade trees affected in this way at the present time, and this means their ultimate destruction, since those that do not die outright will never recover their tops, and are therefore worthless as specimens of shade trees. This dying back is particularly noticeable on elms, which appear to have been affected at the roots for possibly eight years (Figs. 3 and 4). Owing to the different habits of branching, — the rock maple possessing one main leader, while the elm has a number, — their manner

of dying back is different from that of maples. In the latter the most direct channel for the conduction of water is usually through a single leader, while in the elm the water is conducted through several leaders. The center of a maple is therefore affected first, but in the case of the elm the trouble may be noticed in some cases on one side of the tree alone, while in others the whole tree suffers. With some trees the terminal twigs and branches die gradually, it requiring from three to six years for the tree to collapse, while again the tree may die very suddenly. Sometimes a great many of the smaller branches and the remaining branches and twigs are characterized by dense (Fig. 5) tufted foliage. The black oak (*Quercus ellipsoidalis*) and the white oak (*Q. alba*) are affected by winter killing in some sections, and an examination of the roots of numerous trees showed them to be in very bad condition (Fig. 6). A principal feature of the dying back of the oak in some localities is the production of clusters of unusually large and abnormal leaves here and there on the twigs and branches — the tufted foliage already mentioned.

A large number of chestnut trees not affected in any way with chestnut blight have the last three or four years developed staghead. While the symptoms of this dying back are not alike in all cases, they are easily distinguished from those caused by other agents such as gas poisoning, etc. In a majority of cases trees showing this staghead effect, whether from drought or winter killing, die gradually, and even when their death is more or less rapid there are few of the symptoms characteristic of gas poisoning. Trees poisoned by gas usually die quickly and disintegrate rapidly; besides, the diagnostic features to be found in the tissues of trees killed by gas are entirely different. When a tree is affected by gas the poisonous constituents are slowly translocated from one part of the tree to the other, and the symptoms of this type of injury may be easily distinguished from that of other types.

A characteristic feature of trees affected with staghead, more conspicuous in slowly dying trees, may be seen in the increase of the heartwood and decrease of the sapwood. A diminution of the water current in the woody tissue appears to be the cause of this transformation. As a consequence of this dimi-

FIG. 4.—Showing elm slowly dying, with staghead effect.

FIG. 5. — Showing elm branch with tufted foliage. A large percentage of the branches on this tree are dead.

FIG. 6. — Showing winter-killed root from elm tree. Note lack of fine fibrous roots, which have died.

FIG. 7. — Showing elm tree which has lost its outer bark, resulting from injury to cork cambium.

nution the wood of the slowly dying trees is very brittle, and the limbs and branches fall off easily. Old trees reaching the end of their grand period of growth usually show the same characteristics, and for this reason they, too, become dangerous. For many years we have observed the falling of limbs and trees, and have noticed that outside, of course, of tempests, ice storms, etc., a large percentage fall when there is no wind and when the atmosphere is unusually quiet, especially during October and November after the leaves have fallen. The exact cause of this we do not know, although it may be associated with some physical or chemical change in the tissues occurring after defoliation. It is known, however, that water, oils and various chemical substances modify the physical properties of the tissue, and the water contents of a tree at different seasons of the year vary, as shown by Clark,[1] from 25 to 70 per cent., and in severe periods of drought the percentage of water may be very low. That this variation may have some influence here is suggested by the behavior of chemically treated paper containing wood fiber. When wet its tensile strength is increased.

Injury to Cork Cambium.

A great deal of injury to the roots and other parts of trees occurred from the severe cold of the winter of 1903–04. The death of tissue from winter killing is induced by a variety of causes and conditions, and we shall not attempt to discuss them here except to state that any plant, whether indigenous or introduced, is susceptible to winter injury if the conditions are favorable. But it is not always the case that all the living tissues are injured, since winter killing is often local, and even a single tissue may be affected. Following this unusually cold winter many trees died outright, and we found many elms and some sycamores which had lost their outer bark, apparently because of injury to the cork cambium. Sometimes the bark, cortex and phloem were all injured, but in most cases noticed only the outer bark was involved (Fig. 7). This type of injury would not in most cases be noticeable at first, but gradually the dead outer bark which had remained on the tree for

[1] Twenty-second Ann. Rept. Sec'y Mass. State Bd. of Agr., 1874, p. 288.

some time would peel off in reddish flakes, finally crumbling into dust. We have observed cases in which all the outer bark of large sycamore trees extending to the cortex had peeled off without causing any particular harm.

Sun Scald.

Sun scald is a quite common type of injury affecting various maples and other trees, — the apple in particular, where it is often associated with canker (*Sphæropsis*). White pines, also, when thinned too freely, will sun scald severely on the trunk. Many shade trees in our State show injury from this cause, the trouble being more common in some localities than in others. In one section of a city in the eastern part of the State we found a short time ago more than 60 per cent. of the maples suffering from sun scald. The scars were invariably on the sunny side of the tree, and more commonly on the southwestern side, where the maximum temperature was usually found.

Sun scald does not usually involve the whole trunk of large trees, but in many cases, particularly small maples, the whole tree will suffer. A few years ago on one street in a comparatively short distance, sixteen maples might have been seen which had died from sun scald, and at one time most of our wild cornels (*Cornus circinata*) suffered severely from this trouble, many of them never recovering. The moose maple, a shade plant, seldom scalds in its native habitat but when timber is removed and the sun allowed to enter, it is affected. This tree is undoubtedly the most sensitive of any to sun scald.

Most cases of sun scald are followed by an outbreak of *Nectria cinnabarina*, as is often the case with winter killing, and unripened wood is more susceptible to the trouble than well-ripened wood. The under branches of unpruned apple trees are especially susceptible to sun scald, while the upper branches, which receive the light, are affected the least.

Bleeding.

A great many trees suffer from bleeding from different types of injury, such as borers, frost cracks, splitting of the trunk and occasionally linemen's spurs. Often trees filled with cement

bleed, the exudation causing an unsightly appearance of the bark. Bleeding to excess is very injurious. Sometimes the death of trees from this cause is sudden, and in other cases the tree will linger, gradually dying back at the top, and eventually collapsing. The exuded sap, known as "slimy flux," usually contains a large number of micro-organisms which give the sap a peculiar odor. Elm trees often show a white streak on the bark caused by some injury resulting in bleeding, and maples are also quite often affected, sometimes going into a slow decline, followed by death from bleeding alone. In one instance we observed a maple of fairly good size which had frost cracked so badly that it did not live for more than five or six weeks, the numerous cracks extending from the top to the bottom of the trunk. These injuries are a difficult class to treat, and at present no satisfactory method is known.

Injuries from Snow.

Vegetation is occasionally injured by snow. The leaves of coniferous trees — *Pinus Strobus,* for example — are sometimes affected, and the needles on the lower limbs of small pines which have been covered by snowbanks in the spring turn brown and die. But injury from snow is not very common, and has never been known to cause serious harm.

Earth Fillings.

The remodeling and regrading of streets, lawns, etc., often necessitate filling in around trees. These earth fillings are usually fatal to trees, due no doubt as often to the effects of the earth on the bark as to the lack of air to the roots from the deep covering of the soil. We have seen trees growing on a bank with one side of the root system and part of the trunk covered with soil. Those parts covered with soil gradually died, and finally the whole tree collapsed. The maximum depth of soil around the trunk was not more than 8 inches, but the roots were covered for 18 to 20 inches. The soil used for refilling was of a fine texture, — undoubtedly more injurious than a loose-textured soil would have been. In this case the death of the

trees was caused by too close contact of the soil with the bark. When a stone wall is first built around the tree at sufficient distance to allow for future growth, to keep the soil away from the trunk, trees filled in to a height of 5 or 6 feet have been known to survive for many years.

Some trees are undoubtedly more easily injured by earth fillings than others, but building a wall around them to keep the dirt from the trunk, or even the use of cobble stones, brick or coarse gravel close to the trunk, tends to prevent injury. Banking soil for even a few inches around young trees sometimes causes injury. In the case of a young orchard which we observed a few years ago soil was piled up 3 or 4 inches around the trunks of some of the trees for the purpose of protection, but in nearly all instances the tissue underneath was dead, while the trees not treated in this way were all alive.

There are many instances where trees which have been buried partly up the trunk threw out a new root system nearer the surface of the soil. The tree shown in Fig. 8 had been filled in with soil to a depth of 4 feet thirty-five years ago, and in removing the tree it was found that the old stump and roots were all decayed, but the new surface roots had proved sufficient to support the tree.

Exposure of Roots.

Occasional injury occurs to the large roots of trees from regrading and other causes. A few years ago we had occasion to examine a large number of hickory trees (*Carya alba*) located on a country estate which had been injured quite seriously, apparently from sun scald. They had been growing for many years under natural conditions and were fairly vigorous, but during the construction of a large house, and the regrading of the ground, many of the roots — particularly the buttresses — had become exposed. In every case where the soil was taken from the base of the tree and the roots were exposed, the tissue was all sun scalded, but the tissue on the underside of these roots was perfectly normal. In some cases this caused the death of the trees.

It is sometimes possible to expose the larger roots of trees without doing any harm, but at other times sun scald will

FIG. 8.—Trunk of an elm tree showing old trunk and new formation of roots. Photo from W. F. Gale, City Forester, Springfield, Mass.

result. In cities where the streets are constantly being regraded, the surfaces of the larger roots may often be found exposed, but in perfectly normal condition.

Injuries from Various Treatments.

We have at different times had occasion to observe injuries to shade trees brought about by various causes, in many cases resulting from treatment applied by careless or ignorant persons. The present widespread treatment of various pests, as might be expected, has made necessary the testing of different remedies, some of which have proved to be more injurious than the pests themselves. These materials have not only been used by careful people trained in the use of different methods for controlling insects and fungi, but by others who are reckless to the point of seeming to delight in taking chances.

Oil. — Many different oils have been used for spraying insect pests, some of which have proved reliable and others injurious. Kerosene oil can be used on some plants under certain conditions without causing injury, while in other cases it will kill them. A few years ago there was placed on the market a spraying device for the mechanical mixing of kerosene and water in different proportions, but when these materials are mixed mechanically they usually separate, and they have been responsible for the death of many trees. The oil soaks into the bark and often reaches the cambium and sapwood, destroying the tissue; and we have seen quite a few shade trees killed by spraying with kerosene and water to exterminate wooley aphis. In some cases every part of the tree touched by the kerosene was injured, while in others the injury was only local, a more commonly noticed condition on thick-bark trees, while the former case was invariably restricted to trees with thin bark. The bark of trees killed by the use of kerosene presents a different appearance and develops usually a different type of fungous flora from the bark of trees dying from other causes; besides, traces of the oil, which remain on the tree for a long time, can be detected by the sense of smell. A fair diagnosis of this type of injury may be made from specimens of the bark, but when there are comparatively slight local injuries it is best to examine the tree *in situ.* Even slight traces of oil may be

detected by removing small portions of the outer bark on the sunny side of the tree, the sun's heat causing a slight volatilization and perceptible odor.

Gas oil, a heavy oil used in the manufacture of water gas, is very injurious to trees when used as a spray. A few years ago several hundred shade trees were severely injured in one of our eastern cities by spraying the trunks with this oil to kill clusters of gypsy moth eggs, it being used without any knowledge of its adaptability to this purpose (Fig. 9). The oil quickly soaked into the bark, cortical tissue and cambium, and in some cases extended into the sapwood for one-half to three-fourths of an inch. This injury occurred even on trees with fairly thick bark, killing all the living tissue wherever the oil was applied. While in some instances the trees did not show extensive injury, in others the trunks were 50 to 90 per cent. girdled, and many of the trees died from complete girdling. The most striking feature of this case was the ability of the trees to produce perfect foliage even after serious injury had been incurred. One tree was examined whose trunk was girdled for a height of 15 to 20 feet, but this tree persisted in producing foliage for two years after the bark had fallen off. An explanation of this remarkable case consists in the fact that the heavy oil soaking into the sapwood prevented it from checking or cracking, therefore the supply of water from the roots was uninterrupted. The trees treated were elms, different species of maples, etc. The presence of oil in the sapwood in the cases cited above was of the greatest aid in preventing cracking and in helping to maintain the transpiration current and a full crop of foliage, and this bears out the recommendation that tree wounds should be painted or treated in some way very soon after they are formed to prevent cracking. It is sometimes necessary to scrape the wound before applying the paint.

Ordinary house paint, although a crude enough treatment, has sometimes been used by ignorant persons on smooth-bark trees, with of course resultant injury.

Occasionally commercial oils used for spraying fruit trees for the San José scale cause local injury, and some shade trees have been known to be affected by their use.

Oils and other materials to keep down the dust in roadbeds

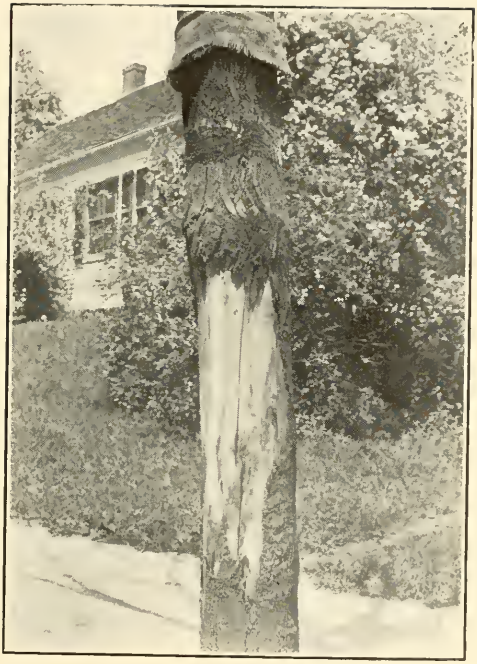

FIG. 9. — Showing effects of spraying heavy oil on trees. The oil penetrated the bark and killed the tissue.

are now much in use, and we have observed some injury from this source, when the trees were located close to the highway and the buttresses of the roots were exposed. The roots are much more susceptible to injury from various causes than are the trunks as they are not so well protected by bark, and when oil sprinkled on a roadbed touches some of the exposed roots it kills the tissue. Particles of dust from oiled roads which sometimes alight on the foliage of trees are said to cause injury, but this type of injury is rare with us. Whether the oil ever extends deeply enough into the roadbeds to reach the root system of trees is not known as yet, but if it does it may cause serious injury. Neither are there specific cases of injury to the roots of trees by the dripping of oil and gasoline from automobiles, although if this leakage were sufficient it might reach the roots and cause injury. Not long ago, however, our attention was called to a tree supposed to have been killed by gasoline leakage from a near-by garage.

Creosote. — This material is used extensively on trees for disinfecting cavities, and mixed with lampblack for painting gypsy moth egg clusters. It does not appear to penetrate to any great extent when combined with lampblack. We have examined a great many trees to discover injuries from its use with no success except in the case of linden roots which had been exposed by regrading, where the underlying tissue was injured. But such instances are rare and the injury purely local in character.

In one case a combination of creosote and naphtha applied to a large number of trees for the destruction of gypsy moth caterpillars appeared to soak into the outer bark, apparently killing the cork cambium, which later resulted in a disintegration of the tissue. Whether these substances did further injury to the tree we were not able to learn.

Coal Tar. — Coal tar is much used for painting wounds and scars caused by pruning, and sometimes injures delicate tissue when first applied. The injury, though, is not serious, as shown by the fact that various saprophytic fungi have been applied over dead, punky wood. Therefore after coal tar has been on for some time it is evidently not injurious to even delicate tissue.

Banding Substances. — A study of the effects of different banding substances has been published in the 1907 report of the Hatch Experiment Station. The writer has since then had an opportunity to study these effects quite extensively. Tanglefoot appears to be the only substance that does not cause injury when applied directly to the bark, *i.e.,* when tarred or other heavy paper is not used. Many laboratory samples of substances resembling tanglefoot have been made up, but in only one instance have any of these materials resembled tanglefoot in practically all its properties; at least, among those which have come to our notice. While the injuries from banding substances have been quite pronounced, practically all of the substances causing injury have now been discarded.

An examination of many trees treated with the so-called tanglefoot has revealed only one case of girdling, and even in this case we were not able to obtain any clue to the manufacturer of the particular material causing the injury. This substance, although resembling tanglefoot, may have been one of its many imitations, some of which are known to cause injury. The only other case of injury from tanglefoot was where it had been applied to the trunk at the same place for a number of years. The oil seemed to penetrate the outer bark to some extent, affecting the texture of the bark; but this injury is not serious, so far as we have observed, and can be prevented by changing the location of the band occasionally. We have never noticed any injury from the use of tanglefoot to the cortical tissue or cambium located just underneath the bark. Our previous experiments show that the most delicate tissue was not injured when it was applied to various plants. But injury was noticed to smooth-bark trees when other banding substances were applied even on tarred paper. Tarred paper alone is capable of injuring the bark of some trees, and the injury mentioned above may have been caused in this way.

Salt. — Salt used on sidewalks, in gutters and on trolley lines in winter has been known to cause injury to the root systems of trees. In one instance we noted injury to several small maples growing near a sidewalk and gutter which had been treated heavily with salt. In one or two other cases where salt

had been used extensively on trolley tracks injury to trees was suspected.

Other Injurious Factors. — Arsenate of soda, potassium cyanide and other chemicals are extremely poisonous to trees, and when placed in holes bored in the tree the two first named will soon cause death. Since arsenate of soda is often used as a weed killer, it is recommended that care be taken in applying it around the feeding roots of trees.

A quite common opinion among line-men is to the effect that copper spikes driven into trees will kill them, but a small maple so treated by us a few years ago showed no abnormal symptoms.

The foliage of different trees is often injured by spraying with various fungicides and insecticides. It is well known that plum and peach foliage is quite susceptible to this type of injury, and even the leaves of maples and other trees may be injured by arsenate of lead. The extent of the injury depends not only on the nature of the spraying solution or mixture used, but also on the condition of the foliage sprayed. We have observed injury to maples from the use of 12 pounds of arsenate of lead to 100 gallons of water, and Paris green, owing to its present-day uncertain composition, often burns foliage.

Burning insect nests with torches, although a common practice, is a bad one, and invariably causes injury. Serious harm often results from burning leaves and grass around trees; and the roots of forest trees, which are often close to the ground, are sometimes injured by burning the underbrush.

In conclusion it might be said that in any treatment of trees one should always have before him some definite object; he should leave strictly alone the numerous irrational methods constantly being advocated, and apply to them first the measuring stick of common sense.

EXPERIMENTS RELATING TO THE CONTROL OF POTATO SCAB.

G. E. STONE AND G. H. CHAPMAN.

Early ideas concerning the nature and cause of potato scab in Europe and America varied quite widely, and the history of the study of this disease and the discovery and isolation of the specific organism causing it, together with the discovery of measures for its control, afford a brilliant example of the efficiency of modern pathological investigations. But it is not our intent to give a detailed account of the history of this disease as that has already been done by Dr. J. C. Arthur,[1] Dr. J. E. Humphrey,[2] Dr. R. Thaxter,[3] and particularly Prof. H. L. Bolley,[4] who has given a very full bibliography of European and American investigators.

From the earliest times many theories have been advanced by different observers relative to the cause of potato scab. Some of these early investigators attribute the cause of the disease to different organisms, while others associate the disease with innumerable factors, such as soil, moisture, etc. Dr. J. C. Arthur [5] appears to have been the first American pathologist to study the causes of potato scab. His early experiments were to determine the influence of various factors which some of the older observers regarded as having a bearing on the cause of the disease. In co-operation with Dr. C. A. Goessmann, however, Dr. J. E. Humphrey was working on the disease along the same lines at practically the same time, although his first publication appeared later than that of Dr. Arthur. On Aug. 26, 1890, Prof. H. L. Bolley, then with the Purdue Agricultural Experiment Station, Ind., read a paper before the Ameri-

[1] J. C. Arthur, 6th Ann. Rept. N. Y. (Geneva) Agr. Exp. Station, 1888, pp. 344–347.

[2] J. E. Humphrey, 6th Ann. Rept. Mass. Exp. Station, 1888, pp. 131–139; also 7th Ann. Rept., 1889, pp. 214–223, and 8th Ann. Rept., 1890, pp. 216–230.

[3] R. Thaxter, Ann. Rept. Conn. Agr. Exp. Station, 1890, pp. 81–95; also 1891, pp. 153–160.

[4] Agr. Science, 1890, Vol. IV., pp. 243–256; also pp. 277–287.

[5] J. C. Arthur, Bul. 56, Purdue Univ. Agr. Exp. Station, 1895.

can Association for the Advancement of Science on potato scab, which was published in the September and October number of "Agricultural Science" the same year, and he established that "(1) the disease is of parasitic origin; that (2) it is for the most part conveyed to the growing crop by infection from the tubers used as seed; that (3) much of the so-called 'smooth seed' is in reality infested with the germs of the disease; and that (4) planting seed tubers free from disease germs gives a crop practically without scab." [1]

His researches and experiments proved to be a great step in advance. While he apparently did not discover the true nature of the organism he paved the way for investigations on the prevention of the disease.[2]

The results of Dr. R. Thaxter's investigations, which were carried on in 1890, were read before the Association of Agricultural Colleges and Experiment Stations November, 1890, and later were published in a report of the Connecticut Experiment Station. His work largely confirmed that of Professor Bolley. He isolated and cultured an organism with which he was able repeatedly to successfully inoculate potatoes and produce the typical scab, although the organism was different from that described by Professor Bolley. It should be noticed that both Professor Bolley and Dr. Thaxter were working on the same lines unknown to each other, and made their results public at nearly the same time, each having arrived at similar conclusions as to the cause of the scab. The organism which Dr. Thaxter isolated was not a bacterium but a low form of fungus possessing more or less indefinite relationships. He later named this, *Oöspora scabies.* Although this organism has been isolated and studied by only a few other pathologists, it is generally recognized that it is the principal if not the only organism associated with the scab. It would not be at all unlikely that the bacterium which Professor Bolley isolated is capable of producing a form of scab; nevertheless, from the viewpoint of treat-

[1] J. C. Arthur, Bul. 56, Purdue Univ. Agr. Exp. Station, 1895.

[2] Professor Bolley was thoroughly convinced that potato scab was caused by a pathogenic organism, and from the first made use of corrosive sublimate in his experiments. He was unfortunate in having very poor material to work with, and informs me that the soil was badly contaminated with the scab and bacteria. Dr. Thaxter observed the fungus growing on the surface of the potato, but Professor Bolley failed to find this, although he found plenty of bacteria.

ment and remedies it matters little whether there is one organism or two associated with the disease. In either case remedies are based on the same principle, *i.e.,* the disease is caused by a pathogenic organism and is infectious.

Professor Bolley [1] later developed a method for preventing the scab which has proved quite effective, at least under certain conditions. This method consists in soaking the seed potatoes in a solution of corrosive sublimate, 23 ounces to 15 gallons, for a period of one and one-half hours. This is to destroy the germs on the seed potatoes, and when this treatment is applied with such necessary precautions as the avoidance of stable manures, etc., it has proved effective, at least when the organisms are not especially abundant in the soil. Experiments with corrosive sublimate were also carried on for three years by Dr. J. C. Arthur,[2] and in the meantime both Professor Bolley and Dr. Arthur were experimenting with formalin, Professor Bolley [3] as a remedy for the smut of wheat, oats and barley, and Professor Arthur as a remedy for the scab. Professor Arthur [4] later published his experiments with the use of formalin as a preventive of potato scab. He shows that formalin (40 per cent. solution), used at the rate of 8 ounces to 10 gallons of water, is effective and equal to corrosive sublimate, besides possessing fewer disadvantages in handling. Corrosive sublimate and formalin have now been in use for many years as a preventive of potato scab, and both have been the means of greatly reducing the disease. As they are designed to kill the organisms on the surface of the tuber and not those in the soil it is always necessary to use other measures to accompany the treatment with the chemicals. Dr. Thaxter from the first recognized the necessity of using clean seed potatoes and the avoidance of stable manures.

Dr. B. D. Halsted [5] has experimented with various substances for the control of potato scab, and he has reported especially favorable results from the use of flowers of sulfur applied to

[1] H. L. Bolley, Bul. 4, North Dakota Agr. Exp. Station, 1891; also Bul. 9, 1893, pp. 19–95.

[2] J. C. Arthur, Bul. 56, Purdue Univ. Agr. Exp. Station (Ind.), 1895.

[3] H. L. Bolley, Bul. 19, N. D. Agr. Exp. Station, 1895; also Bul. 27, 1897, and Bul. 37, 1899.

[4] J. C. Arthur, Bul. 65, Purdue Univ. Agr. Exp. Station (Ind.), 1897.

[5] B. D. Halsted, Bul. 112, N. J. Agr. Exp. Station, 1895; also Bul. 120, N. J. Agr. Exp. Station, 1897.

the soil. He maintains that it not only proved to be the best remedy for the scab but had a wholsome effect on the soil. Dr. Arthur, on the other hand, found sulfur unpromising and discontinued experiments with it. His experience with sulfur was corroborated by Dr. H. J. Wheeler [1] and Mr. G. M. Tucker, who experimented to quite an extent with sulfur and various fertilizers. They found that when sulfur was freely mixed with soil badly contaminated with scab it had no appreciable effect in controlling the disease, and was practically a failure. They found, also, that stable manure of all kinds, wood ashes, air slaked or caustic lime, carbonate of soda, potash, lime and magnesia favored the scab. They obtained a scabless potato with calcium chloride or land plaster (gypsum), and when fertilizers were used without any free lime compounds no scab occurred. They further observed that the marked acidity of the soil or the absence of carbonates was unfavorable to scab. They maintain that when the soil is favorable to the development of scab, or when badly contaminated, the corrosive sublimate treatment is entirely useless as a preventive. The results of Wheeler and Tucker's experiments are in accord with conditions which we have observed in Massachusetts for many years. The presence of carbonates in the soil will increase scab from 2 or 3 per cent. to practically 100 per cent. in a relatively short time, and the use of clean seed, or their treatment with corrosive sublimate or formalin according to the formulas recommended under these conditions, is of little value. On the other hand, when soils are unfavorable for the development of the scab and are only slightly contaminated, formalin and corrosive sublimate are very effective and have been of great value as preventives of this disease.

Experiments with Various Chemicals for the Prevention of Potato Scab.

In the spring of 1908, as a result of much local complaint relative to potato scab and methods of eradication from infested soil, it was thought that it might be possible to treat the soil with certain chemicals and in this way eradicate the trouble.

[1] H. J. Wheeler and G. M. Tucker, Bul. 40, R. I. Agr. Exp. Station Rept. 1896, pp. 80–96.

Wheeler and Tucker have made many observations on the influence of fertilizers on potato scab. They found that such substances as common salt, oxalic acid, calcium chloride and land plaster (gypsum) did not increase the scab, and in some instances appeared to lessen it. Various fungicides and chemical substances have been tried by Arthur and others, some of which were applied to the soil and others to the seed tubers. Many of these have been found beneficial in checking the scab, but none appear to be as effective as corrosive sublimate and formaldehyde.

In our experiments arbitrary substances were taken, some of which under proper conditions were known to have a fungicidal action.

It was thought useless to use fertilizers in excess as a means to the end, as it had been shown that fertilizers as a rule have little or no effect on the increase or decrease of the scab in land, with one exception. It was noted repeatedly on experimental plots at the station that where potash was applied in the form of the carbonate the relative amount of scab was always increased.[1]

The experiments described in the following pages were carried on in circular, lined tiles with a diameter of 23 inches, with therefore an area of approximately 424 square inches, or a soil area of a little less than 3 square feet.

In the application of the substances no attempt was made to bring the quantities used to an amount that would make them commercially valuable, and up to the present time this policy has been carried out, as the idea primarily was to find some substance which would be beneficial in the eradication of the scab, and then work the amount down to a commercial scale.

The potatoes used in all the experiments were free from scab, but were all treated with formalin (1–250) to kill any spores of scab fungus which might be present. After the tubers were dried they were planted in the tiles which contained equal amounts of soil known to be badly infected with the scab fungus.

In the experiments carried on in 1908 the substances and amounts used are shown in Table I. Where liquids were used, the amount of water in indicated proportions was added.

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[1] Influence of Various Potash Salts on Potato Scab, 13th Ann. Rept., Mass. Agr. Exp. Station, 1907, pp. 39 and 133.

Where solid substances were used, the substance was mixed thoroughly with the top 4 inches of soil.

In the following table a check tile was used alternately with a treated tile, and as the amount of scab on the potatoes in all the check tiles was practically the same, the checks are omitted: —

TABLE I. — *Plan of Potato Scab Experiments, 1908.*

Pot Number.	SUBSTANCE USED.	Amount used.
1	Formalin, 1-100,	114 cubic centimeters.
3	Formalin, 1-200,	57 cubic centimeters.
5	Formalin, 1-300,	38 cubic centimeters.
7	Formalin, 1-400,	28.5 cubic centimeters.
9	Potassium permanganate, 1-100,	57 grams.
11	Potassium permanganate, 1-300,	38 grams.
13	Potassium permanganate, 1-400,	28.5 grams.
15	Potassium permanganate, 1-500,	23 grams.
17	Sulfuric acid, 1-200,	57 cubic centimeters.
19	Sulfuric acid, 1-400,	28.5 cubic centimeters.
21	Sulfuric acid, 1-600,	19 cubic centimeters.
23	Sulfuric acid, 1-800,	14.25 cubic centimeters.
25	Acid phosphate,	57 grams.
27	Acid phosphate,	38 grams.
29	Acid phosphate,	28.5 grams.

The potatoes were cultivated in the usual way and allowed to mature. When dug the yield was taken of each pot separately, and the relative amount of scab as compared with the corresponding check tile, but in most cases the yield and amount of scab present closely approximated the check, so nothing of value was obtained from this experiment, as a whole. It was noted, however, that the tiles treated with formaldehyde or formalin were somewhat freer from scab individually; also in the case of the permanganate very little yield was obtained, but the usual amount of scab was present. The sulfuric acid treatment showed possible beneficial effects, but the yield was so small that no accurate comparison could be made.

The experiments, on the whole, were very unsatisfactory, and no deductions of any importance could be made.

The experiments of the season of 1909 were planned in the same manner, but owing to other causes over which we had no control the crop was lost before the examination could be made.

In 1910 the experiment as planned and carried out was as follows: —

Table II. — *Plan of Potato Scab Experiments, 1910.*

Pot Number.	Substance used.	Amount used.
1	Formalin, 1–100,	114 cubic centimeters.
3	Formalin, 1–200,	57 cubic centimeters.
5	Formalin, 1–300,	38 cubic centimeters.
7	Formalin, 1–400,	28.5 cubic centimeters.
9	Potassium permanganate, 1–100,	57 grams.
11	Potassium permanganate, 1–300,	38 grams.
13	Potassium permanganate, 1–400,	28.5 grams.
15	Potassium permanganate, 1–500,	23 grams.
17	Sulfuric acid, 1–200,	57 cubic centimeters.
19	Sulfuric acid, 1–400,	28.5 cubic centimeters.
21	Sulfuric acid, 1–600,	19 cubic centimeters.
23	Sulfuric acid, 1–800,	14.2 cubic centimeters.
25	Sulfur,	50 grams.
27	Sulfur,	100 grams.
29	Sulfur,	200 grams.

Upon examination it was found that the check pots were practically all scabby. This was taken as a basis of 100 per cent. scab, and the results from the various treatments estimated in relation to this basis.

Pots Nos. 1, 3, 5 and 7, which were treated with formalin, showed the presence of scab as follows: in pot No. 1 the potatoes had only 10 per cent. scab, as against 30 per cent for pot No. 3, 24 per cent. for pot No. 5, and 70 per cent. for pot No. 7.

In the pots treated with potassium permanganate no yield was obtained except in one case and one check, and here the potatoes were about 50 per cent. scabby in both cases.

In the sulfuric acid treatment no yields of potatoes were obtained except in the check tile, and they averaged 60 per cent. scab.

In the sulfur treatment the treated pots in general showed a slight gain over the untreated or check pots, but not enough to warrant definite favorable conclusions being drawn.

The plans for the experiments in the season of 1911 were changed somewhat, and other chemicals substituted for some that were previously used. This was the result of the non-action or the negative results obtained from some of the substances used. The whole method of choice of substances was of course haphazard, as no foundation for the use of some was warranted.

In 1911 the chemicals used were as follows, and the only old one to be used was formalin. Table III. gives the plan of the year's experiments: —

TABLE III. — *Plan of Potato Scab Experiments, 1911.*

Pot Number.	SUBSTANCE USED.	Amount used.
1	Steam-sterilized,	– –
3	Steam-sterilized,	– –
5	Steam-sterilized,	– –
6	Steam-sterilized,	– –
7	By-product A,	5 grams (dry).
9	By-product A,	10 grams (dry).
10	By-product A,	10 grams (wet).
12	By-product A,	15 grams (dry).
13	By-product A,	25 grams (dry).
15	By-product A,	40 grams (dry).
16	K permanganate-formalin,	100 cubic centimeters, 6 grams.
18	K permanganate-formalin,	25 cubic centimeters, 10 grams.
19	K permanganate-formalin,	40 cubic centimeters, 16 grams.
21	K permanganate-formalin,	60 cubic centimeters, 24 grams.
22	Copper sulfate, 1–1,000,	– –
24	Copper sulfate (1 gallon), 1–10,000,	– –
26	Carbon bisulfid,	15 cubic centimeters.
27	Carbon bisulfid,	25 cubic centimeters.
29	Carbon bisulfid,	40 cubic centimeters.

In the first series, that of the steam-sterilized, it is noticed that a fair yield of potatoes was obtained, and the amount of scab on the check and treated tiles was as follows: —

	Per Cent Scab.		Per Cent Scab.
Check, ...	40	Steam-sterilized soil, . .	30
Check, ...	18	Steam-sterilized soil, . .	41
Check, ...	30	Steam-sterilized soil, . .	23
Average, ...	29	Average, ...	31

These results surely do not show much benefit from sterilization, and on the whole the amount of scab seemed to increase with the sterilization. The reason for this is not apparent, but may be explained in different ways. In all probability sterilizing the soil in open boxes by heating the soil to 210° or 212° F. was not sufficient to kill the germs of scab. It seems hardly probable that if the organisms had been killed by sterilizing, the soil in the pots could have been contaminated to this extent, or that the seed after being treated with formaldehyde could have been the cause of this.

In the second series a manufacturer's by-product was used, which for the present we will call by-product A. This was applied in different amounts and scattered in the soil both in the powder form and as a paste mixed with water. The three checks averaged 44 per cent. scab, and the treated tiles averaged 30 per cent. scab, with the lowest amount of scab present in the tile treated with the smallest amount of the by-product A. On the whole, this substance seemed to have some beneficial action, although apparently there were discrepancies in the comparative amounts of scab present in relation to the amounts of the substance used.

The next series, made up of gaseous formaldehyde treatment by the reaction of potassium permanganate on formaldehyde, gave no results except in one or two instances, and then the yield was very small and in some cases none at all.

The series of tiles treated with copper sulfate showed that this substance might have a beneficial action in strengths up to 1–10,000, but there was the same amount of scab on the tile treated with copper sulfate, 1–1,000, as there was on the checks.

The yield was small, however, both on the treated tiles and the checks.

The series treated with carbon bisulfid showed some results, the check tiles averaging 50 per cent. scab and the treated tiles showing an average of 20 per cent.

It can be seen that this year's results are showing some improvement over those of preceding years, and by elimination only the most useful compounds are to be used hereafter, with perhaps one or two additions.

TABLE IV. — *Plan of Potato Scab Experiments, 1912.*[1]

Pot Number.	SUBSTANCE USED.	Amount used.
1	By-product A,	100 grams (dry).
2	By-product A,	300 grams (dry).
3	By-product A,	500 grams (dry).
5	By-produet A,	100 grams (wet).
6	By-product A,	200 grams (wet).
7	By-product A,	300 grams (wet).
9	Sulfur,	50 grams (wet).
10	Sulfur,	100 grams.
11	Sulfur,	200 grams.
13	Naphthalene,	50 grams.
16	Steam-sterilized,	– –
17	Steam-sterilized,	– –
18	Steam-sterilized,	– –
20	Formalin, 1-100,	– –
21	Formalin, 1-200,	– –
22	Formalin, 1-300,	– –
23	Formalin, 1-400,	– –
25	Carbon bisulfid,	15 cubic centimeters.
26	Carbon bisulfid,	25 cubic centimeters.
27	Carbon bisulfid,	40 cubic centimeters.
29	Nicine,	100 grams.
30	Nicine,	200 grams.

[1] Numbers omitted were used as check tile. Potatoes treated exactly as in preceding experiments.

In 1912 the experiments were carried on in a similar manner, but for the most part chemical solids were used, with the

exception of the formalin treatment, which remained the same as the preceding years.

The by-product A treatment showed good results, especially when applied dry in 500-gram amounts to the pot area. Even in smaller quantities a decided benefit seemed to be obtained, as can be seen from the following summary: —

Substance used.	Amount used, Dry (Grams).	Per Cent.	Amount used, Wet (Grams).	Per Cent.
By-product A,	100	90	100	50
By-product A,	300	40	200	60
By-product A,	500	2	300	50
Check,	–	90	–	75

Apparently this substance has a good effect. The yield of tubers was in all cases good. If the substance were applied at this rate (500 grams to 3 square feet) it would mean about 7 tons to the acre, but it may be shown that a smaller quantity would be sufficient. Much more work is necessary before any definite opinion can be advanced as to the actual worth of the substance.

The sulfur treatment showed slightly beneficial results, the different tiles and check showing the scab present in the following amounts: —

Sulfur, 50 grams,	70 per cent. scab.
Sulfur, 100 grams,	50 per cent. scab.
Sulfur, 200 grams,	60 per cent. scab.
Check,	85 per cent. scab.

The yield of tubers was good in the case of the sulfur treatment.

The naphthalene treatment showed no results, with very little yield of tubers.

The steam-sterilized tiles, sterilized to a depth of 6 inches, and corresponding check showed scab present in the following amounts: —

Steam-sterilized soil (*a*),	60 per cent. scab.
Steam-sterilized soil (*b*),	40 per cent. scab.
Steam-sterilized soil (*c*),	30 per cent. scab.
Check,	60 per cent. scab.

The yield of tubers was good in all cases.

The formalin treatment gave varying results, and when used in quantities sufficient to do good would be probably impractical. The results with formalin were as follows: —

Formalin 1–100,	30 per cent. scab.
Formalin 1–200,	40 per cent. scab.
Formalin 1–300,	70 per cent. scab.
Formalin 1–400,	70 per cent. scab.
Check,	75 per cent. scab.

The yield was only fair in these tiles.

The carbon bisulfid treatment gave negative results, as may be seen from the following: —

Carbon bisulfid, 15 cubic centimeters, fair yield, 80 per cent. scab.
Carbon bisulfid, 25 cubic centimeters, poor yield, 3 per cent. scab.
Carbon bisulfid, 40 cubic centimeters, no yield.

The Nicine treatment gave no results that could be interpreted as either beneficial or otherwise.

The experiments for 1913 will be planned from an economic point of view, and if possible the same experiments will be carried out for a series of years, and plots used in addition to the tiles.

In summarizing the results of experiments with potato scab it will be noticed that many of the substances used had little effect in preventing scab, while others seemed to possess some value. Steaming the soil the second year was done somewhat more thoroughly than the first year, but the results, on the whole, were similar, *i.e.*, in all the sterilized plots, 1911–12, there was little evidence of reduction of the scab. Steaming under pressure or for prolonged periods under no pressure would determine once for all whether the scab germs are unusually resistant to heat. The heated soil, however, proved to be beneficial to the crop, as the yield was good under this treatment.

The best yield in 1912 was given by by-product A in dry form, followed by the sulfur treatment, and the by-product A wet treatment and steam heating. The most satisfactory treatment from the yield point of view as well as that of treatment

was by-product A, the dry mixture proving superior to the wet. Our experiments with this substance also indicate that any beneficial results from its use are carried over into the next season, since in those plots in which this substance was employed in 1911 the results were noticeable in 1912. The crop obtained by the use of by-product A at the rate of 500 grams to 3 square feet of surface, consisted of the cleanest tubers we have ever observed in a soil which was badly contaminated with scab, and, furthermore, it does not appear in the least to affect the growth or yield (see Fig. 1). The substance appears to act slowly and continuously as a germicide, and may prove even more efficient in the control of other fungi.

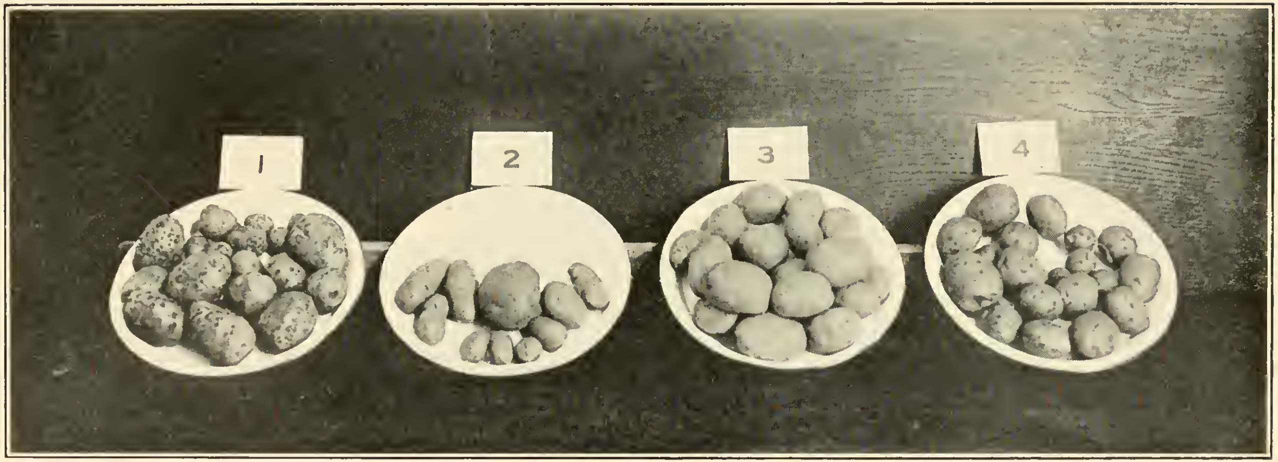

FIG. 1.—Showing treatment of potato scab. All tubers treated with formaldehyde before planting. No. 1, treated with 100 grams of by-product A; No. 2, treated with 300 grams of by-product A; No. 3, treated with 500 grams of by-product A; No. 4, treated with check.

AN OUTLINE OF SOME OF THE TOPICS COVERED BY THE DEPARTMENT OF VEGETABLE PHYSIOLOGY AND PATHOLOGY SINCE ITS INCEPTION.

G. E. STONE.

The department of vegetable physiology was established in the State Experiment Station in 1888, and Dr. James E. Humphrey, under the supervision of Dr. C. A. Goessmann, carried on investigations from November, 1888, to 1892, when he resigned. A bibliography of the more important papers published by the department follows: —

Sixth annual report of the State Experiment Station, 1888: potato scab.

Seventh report, 1889: general account of fungi; potato scab; fungous diseases on the station farm; notes on material referred to the department.

Eighth report, 1890: black knot of plum; mildew of cucumbers; brown rot of stone fruits; potato scab; notes on various diseases.

Ninth report, 1891: rotting of lettuce; powdery mildew of the cucumber; various diseases; preventive treatment.

Tenth report, 1892: diseases of the cucumber plant and violet diseases: the black knot of the plum and cherry; grain rusts; various diseases: treatment for powdery mildew. (From 1892, when Dr. Humphrey resigned, until 1895, the pathological work was temporarily discontinued, but in 1895 the department of vegetable physiology and pathology was established and the work has been continued by the writer since that time.)

Eighth annual report of the Hatch Experiment Station, 1895: this contains mainly an outline of work, and brief references to some experiment topics.

Ninth report, 1896: nature of plant diseases; a bacterial disease of the cultivated strawberry (*Micrococcus sp.?*); stem rot of the cultivated aster; leaf spot of decorative plants; leaf spot of Ficus elastica (*Leptostromella elastica* Ell. & Ev.); a leaf spot disease (*Graphiola Phoenicis* Poit) of the date and similar palms; a leaf spot of the begonia;

a so-called black spot disease of the rose (*Pilobolus crystallinus* Tode); a leaf blight or anthracnose of the cucumber (*Colletotrichum Lagenarium* (Pass.) Ell. & Hals.); an unusual outbreak of two rusts,— asparagus rust (*Puccinia asparagi* D. C.) and a late rust of the blackberry (*Chrysomyxa albida* Kühn.); the tomato mildew (*Cladosporium fulvum* Cke.); a chrysanthemum rust; "drop" of lettuce (*Sclerotinia Libertiana* Fckl.); wilt of maple leaves; topburn of lettuce.

Tenth report, 1897: the causes of the failure of the potato crop of 1897; the "drop" of lettuce; the asparagus rust (*Puccinia asparagi* D. C.); the fire blight (*Bacillus amylovorus* (Burr.) DeToni); quince rust (*Gymnosporangium clavipes* C. & P.); brown rot of stone fruits (*Monilia fructigena* Pers.); the chrysanthemum rust (*Puccinia Tanaceti* S.); some leaf blights of native trees; a leaf blight of the sycamore or buttonwood (*Glœosporium nervisequum* (Fckl.) Sacc.); a leaf blight of the butternut (*Glœosporium Juglandis* (Lib.) Mont.); a leaf spot of the chestnut (*Septoria ochroleuca* B. & C.); a leaf spot of the wild black cherry (*Septoria cerasina* Pk.)

Eleventh report, 1898: scope of work; black spot of the maple (*Rhytisma acerinum* (P.) Fr.); oak leaf blight (*Glœosporium nervisequum* (Fckl.) Sacc.); walnut leaf blight (*Glœosporium Juglandis* (Lib.) Mont.); a muskmelon disease; rotting of cabbage; further considerations in regard to the drop in lettuce; the chrysanthemum rust; a new pansy disease; seasonal peculiarities of certain shade trees; overfeeding of plants; the bronzing of rose leaves; cucumber wilt; some difficulties which city shade trees have to contend with.

Twelfth annual report, 1899: aster diseases; the bacterial cucumber wilt; a geranium disease; muskmelon failures; the maple leaf blight (*Phyllosticta acericola* C. & E.); the chrysanthemum rust; some experiments in growing violets in sterilized soil; the relationship existing between the asparagus rust and the physical properties of the soil.

Thirteenth report, 1900: aster diseases; nematode worms; cucumber mildew (*Plasmopara Cubensis* B. & C.); Russian thistle in Massachusetts; influence of chemical solutions upon the germination of seeds.

Fourteenth report, 1901: the dying of cut-leaved birches; the present status of chrysanthemum rust in Massachusetts; the effects of desiccation on soil; melon failures; stem rots and wilt diseases; the present status of the asparagus rust in Massachusetts; sterilization of soil in greenhouses for fungous diseases.

Fifteenth report, 1902: peach leaf curl (*Exoascus deformans* (Berk.) Fckl.); apple leaf spot; sycamore blight (*Glœosporium nervisequum* (Fckl.) Sacc.); strawberry root rot; apple scab (*Fusicladium dendriticum* (Wallr.) Fckl.); cucumber wilt; sweet pea troubles; aster diseases; potato blight (*Phytophthora infestans* (Mont.) DeBarry); cucumber and melon diseases; asparagus rust (*Puccinia asparagi* D. C.); chrysanthemum rust (*Puccinia Chrysanthemi* Roze); the cucum-

ber mildew (*Plasmopara Cubensis* (B. & C.) Humphrey) in Massachusetts; the muskmelon blight; an apple leaf spot; a strawberry disease; plum "yellows;" spraying of linden and elm trees for leaf spot; crops under tent cloth; experiments in heating soils; influence of sterilized soil on seed germination.

Sixteenth report, 1903: influence of current electricity on plant growth; influence of atmospheric electrical potential on plants.

Seventeenth report, 1904: crops as related to weather conditions; testing of seed; the practice of soil sterilization; influence of electrical potential on the growth of plants; some important literature relating to disease of crops not generally believed to be caused by fungi or insects.

Eighteenth report, 1905: downy mildew of tomato (*Phytophthora infestans* DBy.); potato rot (*Phytophthora infestans* DBy.); cucumber and melon blight; sun scald; burning of conifers and evergreens; winter killing; relation between soil aeration and germination and growth; comparison of sterilized loam and subsoil; influence of soil sterilization on seed germination; an application of the copper sulfate treatment; a comparison of the numbers of bacteria in sterilized and unsterilized soils.

Nineteenth report, 1906: outline of work; seed work; prevalence of fungi, etc.; bacterial disease of cucumbers; bacterial disease of lettuce; bacteriosis of geraniums; tobacco troubles; monilia on peach stem; the lime and sulfur mixture as a fungicide; potato-spraying experiments; banding substances for trees; effects of escaping illuminating gas on trees; germination and growth in soils of different texture; texture of Massachusetts soils.

Twentieth report, 1907: outline of the year's work; seed work; seasonal peculiarities; sun scald; sun scorch premature defoliation of trees; asparagus rust; asparagus Fusarium; peony troubles; potato diseases; experiments with fungicides; influence of various potash salts on potato scab (*Oöspora scabies* Thaxter); investigations relating to mosaic disease; some factors which underlie susceptibility and immunity to disease.

Twenty-first report, 1908: brief notes on the weeds of Massachusetts; results of seed separation; examination of onion seeds for fungous spores; bacterial rot of cabbage and cauliflower; crown gall; the preservation of maple syrup; onion rot; onion smut; a disease of the radish; celery crown rot; eel worms (*Heterodera radicicola* (Greef.) Müll.) on lettuce; influence of water on eel worms; influence of lime on eel worms; effects of chemicals on vegetation; substances and methods used in exterminating weeds; seed work; common weed seeds in grass seed and cattle foods.

Twenty-second report, 1909: diseases more or less common to crops during the year; shade tree troubles; malnutrition; calico or mosaic

disease of cucumber and melon; notes on the occurrence of fungous spores on onion seed; spraying injuries; control of certain greenhouse diseases; damping-off fungi; spraying experiments with calcium benzoate; seed purity work, 1909, seed germination and separation; sun scorch on the pine.

Twenty-third report, 1910: diseases more or less common during the year; seed work, 1910; an outbreak of rusts; sweet pea troubles; a spinach disease new to Massachusetts; condition of fruit trees in general; Fusarium disease of cucumbers and other plants; crown gall; chestnut disease (*Diaporthe parasitica* Murrill); shade tree troubles; the spraying of trees; a new type of spray nozzle; the clogging of drain tile by roots; experiments relating to the prevention of the clogging of drain tile by roots; abnormalities of stump growths; peach and plum troubles.

Twenty-fourth report, 1911: diseases more or less common during the year; seed work for the year 1911; do we need a seed law in Massachusetts; rust on Vinca; bronzing of maple leaves; a notable elm tree; frost cracks; some observations on the growth of elm trees; coarse nozzle versus mist nozzle spraying; a new method for the approximate mechanical analysis of soils; the present status of soil sterilization; influence of soil decoctions from sterilized and unsterilized soils upon bacterial growth; the effects of positive and negative electrical charges on seeds and seedlings; electrical resistance of trees; experiments with rose soils.

List of Bulletins issued by the Department of Vegetable Physiology and Pathology.[1]

Electro-Germination, Asa S. Kinney, Bul. No. 43, 1897.

Nematode Worms, G. E. Stone, R. E. Smith, Bul. No. 55, 1898.

Asparagus Rust, G. E. Stone, R. E. Smith, Bul. No. 61, 1899.

Rotting of Greenhouse Lettuce, G. E. Stone, R. E. Smith, Bul. No. 69, 1900.

Growing China Asters, R. E. Smith, Bul. No. 79, 1902.

Cucumbers under Glass, G. E. Stone, Bul. No. 87, 1903.

Fungicides and Insecticides,[2] G. E. Stone, H. T. Fernald, S. T. Maynard, Bul. No. 80, 1902.

Injuries to Shade Trees from Electricity, G. E. Stone, Bul. No. 91, 1903.

Fungicides and Insecticides,[2] G. E. Stone, H. T. Fernald, F. A. Waugh, Bul. No. 96, 1904.

Tomatoes under Glass, G. E. Stone, Bul. No. 105, 1905.

Blossom End Rot of Tomatoes, Elizabeth H. Smith, Tech. Bul. No. 3, 1907.

Seed Separation and Germination, G. E. Stone, Bul. No. 121, 1908.

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[1] These bulletins are no longer available for distribution by the Agricultural Experiment Station, but may be found in any public library within the State.

[2] Issued in co-operation with other departments.

Fungicides and Insecticides,[1] G. E. Stone, H. T. Fernald, Bul. No. 123, 1908.

Shade Trees,[2] E. A. Start, G. E. Stone, H. T. Fernald, Bul. No. 125, 1908.

Control of Onion Smut, G. E. Stone, Cir. No. 21, 1909.

Lime and Sulfur, G. E. Stone, Cir. No. 31, 1911.

Tomato Diseases, G. E. Stone, Bul. No. 138, 1911.

Microscopic Identification of Cattle Feeds, G. H. Chapman, Bul. No. 141, 1912.

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[1] Issued in co-operation with other departments.

[2] Issued in co-operation with the Massachusetts Forestry Association.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

REPORT OF THE CHEMIST.

JOSEPH B. LINDSEY.

This report is intended to give an outline of the work in progress by this department during the year ending Dec. 1, 1912.

1. Work of the Research Section.

(*a*) Work on the chemistry of insecticides undertaken in co-operation with the department of entomology has been largely completed, and a somewhat comprehensive paper on the subject was published in the twenty-fourth report. A paper on the chemistry of calcium arsenite was also presented by Mr. Holland to the International Congress of Applied Chemistry in September, 1912. Some additional work will be required for several years in testing the purity of the insecticides employed each year in spraying.

A reasonably satisfactory method has been developed for the quantitative determination of the insoluble fatty acids in butter fat. It is now being applied in the analysis of fat produced by cows at the beginning and end of lactation, and of that yielded by fat and thin cows at the beginning of lactation. The objection to the method is the length of time required for its completion. Another method is under consideration which, it is hoped, will yield equally good results in much less time.

The subject of the digestion depression produced by molasses has been further studied by noting its peristaltic action on the intestines. The observations confirmed those previously made, indicating it to be without noticeable effect.

(*b*) Mr. Morse has made distinct progress in his study of

the effect of fertilizers upon asparagus. Phosphoric acid in the ash of the roots was not changed either by the absence or by varying the amounts of phosphate applied to the soil. Potassium oxide in the ash varied with the amounts of potash applied to the soil. Roots collected in the summer of 1911, at the close of cutting for market, showed no apparent exhaustion of nitrogen in them by withholding nitrate of soda until midsummer. Sugar was, however, somewhat depressed by the absence of a spring dressing of nitrate of soda. On the other hand, mature tops collected in October, 1911, gave results showing a small but persistent excess of nitrogen in samples from plots top-dressed with nitrate in the spring.

In case of the plant food requirements of the cranberry, the time has been devoted largely to observations to determine the probable amount of plant food which may be lost in the ditches as well as that which may rise through the peat and sand as the water rises and falls with the changes in rainfall, and the use of water for irrigation and flooding. The total amount added to the irrigation tiles during the summer of 1912 was equivalent to 190,000 gallons per acre. This should, theoretically, carry with it into the sand in which the roots grow some 53 pounds of nitrogen, 30 pounds of phosphoric acid and 85 pounds of potash per acre. Other studies are in progress.

A study of the action of sulfate of ammonia on several of the experiment station plots is in progress and considerable data are being accumulated which, it is hoped, will throw some light upon this perplexing problem.

(*c*) In addition to the above fundamental problems, Dr. Lindsey has continued his studies on the digestibility of cattle feeds, including cottonseed feed meal, cocoanut meal, flax and wheat screenings, flax shives and cocoa shells. An experiment concerning the value of alfalfa hay in milk production has also been completed, and observations are still in progress concerning milk substitutes for rearing dairy calves.

2. Report of the Fertilizer Section.

Mr. Haskins reports as follows: —

Although the principal work of the fertilizer division has been confined to the inspection of commercial fertilizers, yet

during the winter months considerable work was accomplished along other lines. The time available was partly devoted to completing the ash analysis of asparagus roots, this being a continuation of work begun during 1911 in conjunction with fertilizer experiments with asparagus. The ash analysis of tobacco stalks preserved under different conditions has been made for the purpose of showing the variation in composition and of emphasizing the importance of conserving all of the plant food which is furnished by this class of material. The analysis of 14 samples of soil taken from different localities and at different depths has been made to show the tendency of potash to accumulate in the subsoil to a depth of from 3 to 5 feet. This work was undertaken for the purpose of confirming results of analysis of subsoils on field A, which showed a remarkable accumulation of potash. Some time has been given to co-operative work with the American Association of Official Agricultural Chemists, particularly with reference to the study of new and improved methods for the determination of nitrogen, phosphoric acid and potash. The writer has served the association for the past two years as referee on phosphoric acid. Considerable preliminary work has been done in preparation for vegetation experiments on fertilizers to be conducted during 1913. Free examination of refuse by-products, fertilizers and soils has been made for farmers and farmers' organizations as in the past; a more detailed account of this work will be found on a subsequent page.

A larger number of commercial fertilizers has been registered, collected and analyzed during the season than for any previous year. The following summaries will give a fair idea of the work involved and will show the condition of the fertilizer trade for the year: —

(*a*) Fertilizers registered.
(*b*) Fertilizers collected.
(*c*) Fertilizers analyzed.
(*d*) Trade values of fertilizing ingredients.
(*e*) Raw products and chemicals.
  (1) Materials furnishing nitrogen.
  (2) Materials furnishing potash.
  (3) Materials furnishing phosphoric acid.

(*f*) Mixed complete fertilizers.
- (1) Grades of fertilizer.
- (2) Summary of analyses and guarantees.
- (3) Quality of plant food.

(*g*) Ground rock, mineral fertilizer or stonemeal.
(*h*) Lime compounds.
(*i*) Free analyses of by-products, fertilizers and soils.

(*a*) *Fertilizers registered.*

Ninety-seven manufacturers, importers and dealers, including the various branches of the trusts, have secured certificates for the sale of 509 different brands of fertilizer, agricultural chemicals, raw products and agricultural lime in the Massachusetts markets. This is 17 more than were registered during the previous year. They may be classed as follows: —

Complete fertilizers,	328
Fertilizers furnishing phosphoric acid and potash,	9
Ground bone, tankage and dry ground fish,	55
Chemicals and organic nitrogen compounds,	91
Agricultural limes,	26
	509

(*b*) *Fertilizers collected.*

An effort has been made to procure a representative sample of every brand of fertilizer and lime which has been registered in Massachusetts, and with few exceptions the effort has been successful. During the early part of April, arrangements were made, upon request, to sample carloads of cottonseed meal, wood ashes, fertilizers and chemicals, these earlier shipments being materials which were purchased for private use by some of the larger consumers. Although this practice has made it necessary to make a much larger number of analyses than formerly, yet it has some good features as it insures the inspection of a larger tonnage than would otherwise be possible, besides furnishing the large consumer an analysis of his particular shipment. Large shipments of many private formulas have been sampled upon request.

The inspectors have, during the year, sampled about 5,600

tons of fertilizer of all kinds, and in doing this have drawn from over 15,000 bags. They visited 138 towns, called upon 329 different agents, and drew 1,180 samples representing 527 distinct brands; this is 117 more samples, representing 45 more brands, than were taken during the previous year.

(c) *Fertilizers analyzed.*

Seven hundred and two analyses have been made during the year's inspection; they may be grouped as follows: —

Complete fertilizers,	431
Fertilizers furnishing phosphoric acid and potash, such as ashes,	16
Ground bone, tankage and fish,	68
Nitrogen compounds, both organic and mineral,	87
Potash compounds,	42
Phosphoric acid compounds,	33
Lime compounds,	25
	702

(d) *Trade Values of Fertilizing Ingredients.*

At a meeting of representatives of the experiment stations of New England, New York and New Jersey, held during the first week of March, 1912, the following table of trade values was adopted. The trade values represent the average cash cost per pound at retail of nitrogen, potash and phosphoric acid as furnished by chemicals and standard unmixed fertilizing material in the principal markets in New York and New England. The data which are used in obtaining these values are the average wholesale quotations of chemicals and raw materials as found in commercial publications from Sept. 1, 1911, to March 1, 1912, plus about 20 per cent.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1911 and 1912.

	Cents per Pound.	
	1911.	**1912.**
Nitrogen: —		
In ammonia salts,	16.00	16.50
In nitrates,	16.00	16.50
Organic nitrogen in dry and fine ground fish, meat and blood,	23.00	22.00
Organic nitrogen in fine [1] bone, tankage and mixed fertilizers,	20.00	19.00
Organic nitrogen in coarse [1] bone and tankage,	15.00	15.00
Organic nitrogen in cottonseed meal, castor pomace, linseed meal, etc.,	21.00	20.00
Phosphoric acid: —		
Soluble in water,	4.50	4.50
Soluble in neutral ammonium citrate solution (reverted phosphoric acid),[2]	4.00	4.00
In fine-ground [1] bone and tankage,	4.00	4.00
In coarse [1] bone, tankage and ashes,	3.50	3.50
In cottonseed meal, castor pomace and linseed meal,	4.00	4.00
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers,	2.00	2.00
Potash: —		
As sulfate free from chlorides,	5.00	5.25
As muriate (chloride),	4.25	4.25
As carbonate,	8.00	8.00
In cottonseed meal, castor pomace, linseed meal, etc.,	5.00	5.00

[1] Fine bone and tankage are separated from coarse bone and tankage by means of a sieve having circular openings one-fiftieth of an inch in diameter. Valuations of bone and tankage are based upon degree of fineness as well as upon composition.

[2] Dissolved by a neutral solution of ammonium citrate, specific gravity, 1.09, in accordance with method adopted by the Association of Official Agricultural Chemists.

(*e*) *Raw Products and Chemicals.*

Forty-five samples of ground bone, representing 32 analyses, have been collected and examined. The average retail cash price has been $32.63, and the average commercial valuation as calculated by the table of trade values has been $29.24. Ground bone has averaged 3.12 per cent. nitrogen, 75.32 per cent. of which has been found active by the alkaline permanganate method.

Twenty-eight samples of tankage have been inspected. The average retail cash price for tankage has been $33.19, and the average commercial valuation as calculated by the table of trade values has been $33.05 per ton. Tankage has averaged 6.58 per cent. total nitrogen, of which 75.38 per cent. has been found active by the alkaline permanganate method. Nitrogen in fine tankage has cost on the average 19.08 cents; nitrogen in coarse tankage has cost 15.06 cents per pound.

Four analyses of dissolved bone have been made. The aver-

age retail cash price has been $30.25, and the average commercial valuation as calculated by the table of trade values has been $23.27 per ton. Dissolved bone has averaged 2.60 per cent. nitrogen, 71.16 per cent. of which has been found active by the alkaline permanganate method.

Thirteen analyses of dry ground fish have been made, representing 32 samples. The average retail cash price per ton has been $42.16 and the average calculated commercial valuation $41.59 per ton. Nitrogen from dry ground fish has cost on the average 22.3 cents per pound.

(1) *Materials furnishing Nitrogen.* — Eight samples of dried blood have been examined, representing 6 analyses. Blood has averaged 10.46 per cent. total nitrogen, about 74 per cent. of which has been found active by the alkaline permanganate method. The average retail cash price for blood has been $50.74 per ton, and the average calculated commercial valuation, $48.26 per ton. The average pound cost of nitrogen from blood has been 23.13 cents.

Two samples of castor pomace have been analyzed, both of which have been found up to the guarantee. The average retail cash price has been $25.50, and the average commercial valuation calculated by the table of trade values has been $19.24 per ton. The average cost of nitrogen in this form has been 26.51 cents per pound. Castor pomace has shown on the average 4.81 per cent. nitrogen, about 54 per cent. of which has been found active by the alkaline permanganate method.

Fifty-six samples of cottonseed meal have been examined. Each sample represents a carload, and all of the material inspected was bought as a nitrogen source, largely for tobacco. The average retail cash price has been $31.45, and the average calculated commercial valuation, $25.95 per ton. The average pound cost of nitrogen in this form has been 24.24 cents. Cottonseed meal has averaged 6.49 per cent. nitrogen, about 56 per cent. of which has been found active by the alkaline permanganate method.

Thirty-nine samples of nitrate of soda have been examined, representing 16 analyses: all but one sample was found fully up to the guarantee. Nitrate of soda has cost on the average

$50.70, and the average commercial valuation calculated by the table of trade values has been $51.03 per ton. The pound price of nitrogen from this source has been 16.39 cents.

Six analyses of sulfate of ammonia have been made, representing 7 samples; all have been found of good quality. The average retail cash price per ton has been $71.13, and the calculated commercial valuation, $72.28 per ton. The average cost of a pound of nitrogen in this material has been 16.23 cents.

(2) *Materials furnishing Potash.* — Eighteen analyses of high-grade sulfate of potash have been made, representing 31 samples. The average retail cash price of this potash salt has been $50.78, and the average commercial valuation calculated from the table of trade values has been $51.47 per ton. The pound of actual potash in this form has cost on the average 5.18 cents.

Five analyses of potash-magnesia sulfate have been made, representing 9 samples. The average retail cash price has been $29.50, and the average commercial valuation calculated from the table of trade values has been $28.80 per ton. The pound of actual potash in this form has cost 5.38 cents.

An article offered as double sulfate of magnesia and potash was not *bona fide,* but evidently high-grade sulfate of potash and sulfate of magnesia reduced with sand. It contained 21.6 per cent. material insoluble in hot water, the greater part of which was unquestionably sand. The case is probably similar to several which were detected last year, and which proved to be cases where the mines in Germany had reduced high-grade sulfate of potash with sand in order to fill orders for potash-magnesia sulfate, of which there was a temporary shortage. Dr. Huston, of the German Kali Works, states that the practice is not tolerated by his company, and heavy shipments have been returned at the expense of the mines furnishing the material, and in all cases where this practice has been detected heavy fines have also been imposed. The amount of material involved in this particular case was not large, only 1½ tons being bought by one party for his own use.

Fifteen analyses of muriate of potash have been made, representing 31 samples. The potash guarantee was maintained in

all but one case, and in this exception the commercial shortage was less than 50 cents per ton. The average retail cash price has been $42.58, and the calculated commercial valuation, $43.83 per ton. The pound of actual potash as muriate has cost on the average 4.13 cents.

(3) *Materials furnishing Phosphoric Acid.* — Only two samples of dissolved bone black have been analyzed, one of which showed a commercial shortage of over 50 cents per ton.

Fourteen analyses of acid phosphate have been made, representing 25 samples. The average retail cash price has been $15.35, and the average commercial valuation calculated from the table of trade values has been $13.67 per ton. The pound of available phosphoric acid from acid phosphate has cost 4.77 cents.

Seventeen analyses of basic slag phosphate have been made, representing 23 samples. Four analyses showed samples deficient in available phosphoric acid. The average retail cash price paid for basic slag was $15.19, and the average calculated commercial valuation, $12.64 per ton. The pound of available phosphoric acid from basic slag, as determined by the Wagner method, has cost on the average 4.81 cents. Two brands showed a commercial shortage of over 50 cents per ton.

(*f*) *Mixed Complete Fertilizers.*

The larger number of high-grade fertilizers that are being sold from year to year in Massachusetts indicates that the average farmer realizes the importance of purchasing a high-grade mixture. As has been pointed out in past years, there are many advantages to be gained by choosing a formula from among the high-grade goods. Summary tables have been prepared which furnish valuable data bearing upon this point.

(1) *Grades of Fertilizer.* — In separating the formulas into different grades, those brands containing plant food having a commercial value of $24 or over per ton have been classed as high grade, those having a value between $18 and $24 per ton medium grade, and those having a value of $18 or less per ton low grade.

Table showing Average Cash Price and Commercial Plant Food Value per Ton, also Money Difference between Cash Price and Plant Food Value.

	High Grade.		Medium Grade.		Low Grade.	
	1911.	1912.	1911.	1912.	1911.	1912.
Average retail cash price a ton,	$40.87	$38.23	$35.08	$33.26	$29.64	$29.76
Average retail cost of plant food in a ton.	28.89	27.84	21.04	20.74	15.37	14.58
Average money difference, .	11.98	11.16	14.04	12.52	14.27	15.16

The above table shows: —

1. That the average ton price of the three grades of fertilizer has been $1.42 less, and the average cost of plant food in a ton 66 cents less, than for the previous season.

2. That the low-grade goods were the only class which sold on the average at a slightly higher ton cost than during the previous year.

3. That the percentage excess of the selling price over the commercial value of plant food in the low-grade fertilizers is over two and one-half times more than in the high-grade goods, and about one and three-fourths times more than in the medium-grade fertilizers.

4. That with a 28.5 per cent. advance in price over the low-grade fertilizer, the high-grade furnishes about 91 per cent. increase in commercial plant food value.

5. That the money difference between the average selling price and the average valuation in the high-grade fertilizers is $4 less than in the low-grade goods. It probably costs no more to manufacture a ton of low-grade goods than it does a ton of the high-grade; besides, in the low-grade fertilizer opportunities are offered for the use of low-grade ammoniates and low-grade potash compounds. These facts all emphasize the many advantages to be gained by buying only high-grade mixtures.

Table showing the Average Composition of the Three Grades of Fertilizer.

Grade.	Number of Brands.	Per Cent. of Whole Number.	Nitrogen.			Phosphoric Acid.			Potassium Oxide.	Pounds of Available Plant Food in 100 Pounds of Fertilizer.
			Total.	Percentage Availability of Total Nitrogen.	Percentage Availability of Organic Nitrogen.	Soluble.	Reverted.	Available.		
High, . . .	165	48.25	3.94	85.28	68.65	3.90	3.52	7.42	7.75	19.11
Medium, . .	105	30.88	2.59	83.40	64.46	4.46	3.25	7.71	5.08	15.38
Low, . . .	72	21.18	1.66	75.90	60.00	4.36	2.74	7.10	2.83	11.59

The above table shows: —

1. That a ton of the average high-grade fertilizer furnishes 45.6 pounds more nitrogen and 98.4 pounds more actual potash than does a ton of the low-grade goods.

2. That a ton of the average high-grade fertilizer furnishes 27 pounds more nitrogen and 53.4 pounds more potash than does a ton of the medium-grade goods.

3. That with a 28.5 per cent. advance in price over the low-grade fertilizer, the high-grade furnishes about 65 per cent. increase in available plant food.

4. That the average high-grade fertilizer with about 15 per cent. advance in price over the medium-grade goods, furnishes over 24 per cent. more plant food and 34 per cent. increase in commercial value.

5. That the percentage activity of the total nitrogen is 9.38 per cent., and the percentage activity of the organic nitrogen is 8.65 per cent. more in the high-grade fertilizer than in the low-grade brands. This would indicate the superior quality of plant food in the high-grade brands, which is still another advantage in purchasing the latter class of fertilizer.

Table showing the Comparative Pound Cost of Nitrogen, Potash and Phosphoric Acid in its Various Forms in the Three Grades of Fertilizer.

FORM OF ELEMENT.	Low-grade Fertilizer (Cents).	Medium-grade Fertilizer (Cents).	High-grade Fertilizer (Cents).
Nitrogen (as nitrates and ammoniates),	33.7	26.5	22.6
Nitrogen (organic),	38.8	30.5	26.1
Potash (as muriate),	8.7	6.8	5.8
Soluble phosphoric acid,	9.2	7.2	6.2
Reverted phosphoric acid,	8.2	6.5	5.5
Insoluble phosphoric acid,	4.1	3.2	2.7

This table shows: —

1. That the purchase of high-grade fertilizers in place of low-grade has saved nearly 12 cents on every pound of nitrogen and nearly 3 cents on every pound of potash and phosphoric acid.

2. That the purchase of high-grade fertilizers in place of medium grade has saved 4¾ cents on every pound of nitrogen and nearly 2 cents on every pound of potash and phosphoric acid.

3. That the cost of the several elements of plant food in the average high-grade fertilizer amounts to $37.65 a ton. If the farmer purchases this same amount of plant food on the basis of the cost of the fertilizer elements in the low-grade fertilizer, he would pay $56.17. In other words, he would pay $18.52 more for the same plant food if purchased in the form of low-grade fertilizer; and he would pay $12.06 more for it if purchased in the form of medium-grade fertilizer.

4. That about 52 per cent. of the brands of fertilizer sold in the State are classed as low and medium grade. This is by far too large a proportion, as it means that those purchasing this class of goods are paying an excessive price for the actual plant food obtained, which in the aggregate must amount to many thousands of dollars.

5. That it would be much more economical to buy only high-grade fertilizers and use less per acre. The brand should be selected which comes nearest fulfilling the plant-food requirements in each individual case.

(2) *Summary of Results of Analyses of the Complete Fertilizers as compared with the Manufacturer's Guarantee.*

Manufacturer.	Number of Brands analyzed.	Number with All Three Elements equal to Guarantee.	Number equal to Guarantee in Commercial Value.	Number with One Element below Guarantee.	Number with Two Elements below Guarantee.	Number with Three Elements below Guarantee.
W. H. Abbott,	3	2	3	1	–	–
Alphano Humus Company,	1	1	1	–	–	–
American Agricultural Chemical Company,	76	33	66	34	8	1
Armour Fertilizer Works,	10	6	10	4	–	–
Beach Soap Company,	6	4	6	2	–	–
Berkshire Fertilizer Company,	15	12	15	3	–	–
Bowker Fertilizer Company,	26	19	23	6	1	–
Jos. Breck & Sons,	3	1	3	2	–	–
Buffalo Fertilizer Company,	8	6	7	2	–	–
The E. D. Chittenden Company,	6	4	5	1	1	–
Clay & Son,	1	1	1	–	–	–
Coe-Mortimer Company,	17	10	16	6	1	–
Eastern Chemical Company,	1	–	1	1	–	–
Essex Fertilizer Company,	9	2	6	5	2	–
C. W. Hastings,	1	1	1	–	–	–
Hubbard Fertilizer Company,	5	1	5	1	3	–
Listers' Agricultural Chemical Works,	9	6	9	3	–	–
J. E. McGovern,	1	1	1	–	–	–
Mapes' Formula and Peruvian Guano Company,	18	14	18	4	–	–
National Fertilizer Company,	15	6	11	9	1	–
Natural Guano Company,	1	1	1	–	–	–
New England Fertilizer Company,	7	6	7	1	–	–
Olds & Whipple,	7	6	7	1	–	–
Parmenter & Polsey Fertilizer Company,	8	6	8	1	1	–
R. T. Prentiss,	3	2	2	1	–	–
Pulverized Manure Company,	2	1	1	–	–	1
Rogers Manufacturing Company,	10	7	10	3	–	–
Rogers & Hubbard Company,	9	8	9	1	–	–
Ross Bros. Company,	4	2	3	2	–	–
Sanderson Fertilizer and Chemical Company,	8	5	8	3	–	–
M. L. Shoemaker & Co., Ltd.,	2	2	2	–	–	–
Swift's Lowell Fertilizer Company,	16	12	16	4	–	–
20th Century Specialty Company,	3	2	3	1	–	–
Wm. Thomson & Sons,	2	1	2	1	–	–
Whitman & Pratt Rendering Company,	5	5	5	–	–	–
Wilcox Fertilizer Company,	9	9	9	–	–	–
A. H. Wood & Co.,	3	2	3	1	–	–

This table shows: —

1. That out of a total of 330 brands of complete fertilizers collected and analyzed, 124 (38 per cent. of the total number) fell below the manufacturer's guarantee in one or more elements.

2. That 104 brands were deficient in one element.

3. That 18 brands were deficient in two elements.

4. That 2 brands were deficient in all three elements.

5. That 26 brands (about 8 per cent. of the whole number analyzed) showed a commercial shortage; that is, the value of the plant food found did not equal the value of the plant food

guaranteed, although overruns were used to offset shortages. The deficiencies found were divided as follows: —

73 brands were found deficient in nitrogen.
31 brands were found deficient in available phosphoric acid.
42 brands were found deficient in potash.

6. That, compared with the previous year, a much better showing has been made. Fewer deficiencies have occurred, also a less number of commercial shortages. The number of nitrogen, available phosphoric acid and potash shortages were, respectively, 23 less, 59 less and 24 less than for the season of 1911. The brands showing a commercial shortage were 2 less than for the previous year.

Table showing Commercial Shortages (25 Cents and Over) in Mixed Commercial Fertilizers for 1911 and 1912.

Commercial Shortages.	Number of Brands.	
	1911.	1912.
Between $1 and $2 per ton,	9	8
Under $1, not less than 25 cents per ton,	17	15

A number of instances have occurred, as is frequently the case, where serious shortages of some one element have been found and yet the brands have not suffered a commercial shortage, the deficiencies being made up by overruns of some other element. Although this is not a desirable feature, perhaps it cannot always be avoided in the rush season.

(3) *Quality of Plant Food.* — A very full discussion of the quality of the plant food entering into the composition of mixed fertilizers will be found in our Fertilizer Bulletin No. 143. In general it may be said that the quality of the organic nitrogen used in fertilizers found in the Massachusetts markets showed an improvement over last year. The phosphoric acid guarantees, as a whole, were well maintained. There are indications that considerable nonacidulated phosphoric-acid-containing material enters into the composition of mixed fertilizers, being probably derived from tankage and partly acidulated bone. The potash guarantees were better maintained than during the

past year, and in most instances the form of potash was as guaranteed. The misleading practice of stating the sulfate of potash equivalent when the potash is actually present in form of muriate is still prevalent to some extent. Every formula has, therefore, been tested to show the form of potash actually present.

(g) *Ground Rock, Mineral Fertilizer or Stonemeal.*

The indications are that not much of this class of materials has been sold in the Massachusetts markets. The inspectors were not able to find it in the hands of agents, and it was probably sold by the manufacturer through soliciting agents direct to the farmer.

A sample of New Mineral Fertilizer, manufactured by the New Mineral Fertilizer Company of Boston, was taken by one of our inspectors from stock carried by the manufacturer. The analysis of this showed the presence of .09 per cent. nitrogen, .38 per cent. total phosphoric acid and .10 per cent water-soluble potash. The calculated commercial value of the material was 57 cents per ton. Extravagant claims are made by the company for the fertilizing value of the silica, chlorine, sulfur, soda, lime, magnesia, iron and alumina which the material, like all rocks and soils, contains. The ordinary soil usually contains an abundance of these elements with the possible exception of lime. Assuming the ton price to be the same as last year, $17, a pound of nitrogen would have cost $5.67, a pound of insoluble phosphoric acid 60 cents, and a pound of water-soluble potash $1.27.

Dr. Charles D. Woods, director of the Maine Agricultural Experiment Station, has conducted field experiments with this material.[1] The results of the experiment were stated as follows by Director Woods: —

"It will be noted that both with the corn and with the potatoes, there was a somewhat smaller yield on the plots to which New Mineral Fertilizer was applied than upon the plots which received no fertilizer. The comparative yields seem clearly to point out that there was no benefit from the use of the New Mineral Fertilizer."

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[1] See description of the experiment in the American Fertilizer, Philadelphia, Pa., Vol. XXXVII., No. 9, pp. 28-29.

The Massachusetts station intends to conduct some experiments with this fertilizer the coming season.

Two samples of Stonemeal, manufactured by the Stonemeal Fertilizer Company of Paterson, N. J., who have an office in Springfield, Mass., were collected and analyzed. Although this material contains a little more potash and phosphoric acid than did the New Mineral Fertilizer, yet it must be placed in the same class.

(*h*) *Lime Compounds.*

Our new fertilizer law was drafted to include the inspection of lime used for agricultural purposes. The year 1912 marks the first official inspection of lime which has ever been made in the State.[1]

Forty-four samples representing 21 brands were taken from 36 different agents in 24 different towns; 25 analyses have been made.

Lime for agricultural purposes includes slaked or hydrated lime, caustic or burnt lime, carbonate of lime, such as ground limestone, marl and wood ashes; also gypsum or land plaster (sulfate of lime). Detailed results of the analyses will be found in our Fertilizer Bulletin, including the actual cost of 100 pounds of calcium and magnesium oxides derived from different sources.

(*i*) *Free Analysis of By-products, Fertilizers and Soils.*

Two hundred and sixty-three different substances have been received and analyzed from farmers, farmer organizations and the various departments of the experiment station. The materials may be classed as follows: fertilizers and by-products used as fertilizers, 200; soils, 40; lime compounds, 13; ash analysis of plants, 8; miscellaneous products, 2.

Many of these materials have been sampled by our regular inspectors; some were taken by the party requesting the analysis by means of a sampling tube forwarded from the station for that purpose. In all cases the samples were drawn according to directions furnished from this office. It may be assumed, therefore, that the samples were representative of the products

[1] For a discussion of the rational use of lime, ask for Bulletin No. 137.

in question. In reporting results of analysis, full information is given as to commercial value of the product and the best manner of using it. In many cases where a by-product does not have the plant food constituents present in the right proportion, suggestions are made as to the best manner of balancing the material by the addition of chemicals. In reporting analyses of lime products it has been the custom to furnish not only the chemical analysis but also the probable proportion of the various forms of lime and magnesia present; *i.e.*, whether caustic, hydrated (slaked) or carbonate of lime and magnesia were present, and amounts of each.

In reporting soil analysis, information has been furnished as to treatment with lime, manures and fertilizers.

With the exception of some of the lime products, chemicals and complete fertilizer formulas which have been collected by our inspectors, and which appear in a table by themselves in the Fertilizer Bulletin, the analyses above mentioned will not be published.

3. Report of the Feed and Dairy Section.

Mr. P. H. Smith submits the following: —

The Feed Law (*Acts and Resolves for 1903, Chapter 122*).

During the year, 902 samples of commercial feeding stuffs have been collected by James T. Howard, official inspector. These samples have been examined, and the analytical results together with additional information are given in Bulletin No. 142.

The year has been uneventful in that the law has been well complied with, and few new feeding stuffs have been found. Prices have ruled high, and our inspector reports that the stock on hand has been, during parts of the year, very low. This was due to the difficulty of getting shipments promptly and to the fact that, owing to the uncertainty of the market, dealers did not care to stock heavily.

The most important event of the year was the enactment of a new feeding stuffs law which took effect Sept. 1, 1912. This

law is printed in full in Bulletin No. 142 of this station and also as Circular No. 34.

The new law differs from the law which it replaces in the following essentials: —

1. *Guarantee.* — In addition to a guarantee of the minimum percentage of protein and fat, as formerly required, a guarantee of the maximum fiber content must also be given. In case of mixed or compounded feeds, a statement of the ingredients contained therein must be included in the guarantee.

2. *Registration.* — Registration of all feeding stuffs is now necessary, although no fee is required. Upon application, the proper forms for registration will be forwarded.

3. *Appropriation.* — In place of the $3,000 formerly allowed for carrying out the provisions of the act, $6,000 is now appropriated.

4. *Phraseology.* — The law has been put in such form as to be more explicit in the statement of its requirements. Before being submitted for enactment, the text was carefully reviewed not only by officials of this station, but by those of other experiment stations, and also by a committee of feed dealers from the Boston Chamber of Commerce. It was finally submitted to a competent attorney for corrections and approval.

5. *Wheat feeds* are now included; in the former law these were omitted.

The law practically conforms to the uniform law advocated by the Association of Feed Control Officials, which has received the indorsement of the American Feed Manufacturers' Association.

It is felt that the new law will more effectually safeguard the interests of the Massachusetts farmer than the former act, and that the compliance with its requirements will not be any more difficult for the honest manufacturer or jobber. The earnest co-operation of all interested in the manufacture, sale or consumption of commercial feeding stuffs is most earnestly desired.

The acknowledgment is made of the co-operation of members of the Boston Chamber of Commerce, of the secretary of the State Board of Agriculture, of a representative of the State Grange, and of others in securing the passage of the law.

The Dairy Law (Acts and Resolves for 1912, Chapter 218).

This act as originally passed in 1901 required that all persons using the Babcock test as a basis of payment for milk or cream, either in buying or selling, must secure a certificate of proficiency from the experiment station. It also required that Babcock machines be inspected by an experiment station official annually, and that all glassware be tested for accuracy by the station. The act was amended in 1909 (chapter 425, Acts and Resolves for 1909), giving to the director of the experiment station the authority to revoke the certificate of an operator found to be using dirty or untested glassware or doing the work in an improper manner.

A redraft of the entire law made to include milk inspectors was presented to and passed by the Legislature of 1912, the full text of which follows: —

An Act to regulate the Use of Utensils for testing the Composition or Value of Milk and Cream.[1]

Be it enacted, etc., as follows:

Section 1. No bottle, pipette, or other measuring glass or utensil shall be used in this commonwealth by any inspector of milk or cream, or by any person in any milk inspection laboratory, in determining, by the Babcock or other centrifugal machine, the composition of milk or cream for the purposes of inspection; or by any person in any milk depot, creamery, cheese factory, condensed milk factory or other place in determining, by the Babcock or other centrifugal machine, the composition or value of milk or cream as a basis for payment in buying or selling, until it has been tested for accuracy and verified by the director of the Massachusetts agricultural experiment station, or by his duly designated deputy or deputies. Every such bottle, pipette, or other measuring glass or utensil shall be submitted to the said director by the owner or user thereof, to be tested for accuracy before the same is used in this commonwealth for the purposes aforesaid. The owner or user shall pay to the said director for the use of the said station as a fee for making the test, a sum not exceeding five cents for each bottle, pipette, or other measuring glass or utensil tested. Any bottle, pipette, or other measuring glass or utensil that has been tested and verified as aforesaid shall be marked by the director or by his said deputy or deputies to indicate the fact, or if tested and found to be inaccurate may be marked by him or them to indicate that it is inaccurate. No bottle,

[1] Chapter 218, Acts and Resolves of 1912.

pipette, or other measuring glass or utensil that has been marked by the said director, or by his duly designated deputy or deputies, to indicate that it is inaccurate shall be used in this commonwealth by any person in determining the composition or value of milk or cream.

SECTION 2. Every Babcock or other centrifugal machine used in this commonwealth by any inspector of milk or cream, or by any person in any milk inspection laboratory for determining the composition of milk or cream for purposes of inspection, or by any person in any milk depot, creamery, cheese factory, condensed milk factory or other place for determining the composition or value of milk or cream as a basis for payment in buying or selling, shall be subject to inspection at least once in each year by the director of the Massachusetts agricultural experiment station or by an inspector or deputy of the said director. The owner or user of any such centrifugal machine shall pay to the said director for the use of said station as a fee for making such annual inspection the actual cost of such inspection for each machine inspected.

Any Babcock or other centrifugal machine used as aforesaid that is not, in the opinion of the director, or of an inspector or deputy of the said director, in condition to give accurate results, may be condemned by the director or by his inspector or deputy. No Babcock or other centrifugal machine that has been condemned by said director or by an inspector or deputy of the director as not in condition to give accurate results shall be used in this commonwealth by any person for determining the composition or value of milk or cream as aforesaid, unless the machine be changed to the satisfaction of the said director or of his inspector or deputy, and approved by him.

SECTION 3. No inspector of milk or cream, and no person in any milk inspection laboratory, shall manipulate the Babcock or other centrifugal machine for the purpose of determining the composition of milk or cream for purposes of inspection, and no person in any milk depot, creamery, cheese factory, condensed milk factory, or other place in this commonwealth shall manipulate the Babcock or other centrifugal machine for the purpose of determining the composition or value of milk or cream as a basis for payment in buying or selling, without first obtaining a certificate from the director of the Massachusetts agricultural experiment station, or his duly designated deputy, that he is competent to perform such work. The fee for such certificate shall be two dollars, and shall be paid by the applicant therefor to the said director for the use of the said station. In case any holder of a certificate is notified by the director, or by his duly designated deputy, to correct his use of a Babcock or other centrifugal machine, the actual cost of making an inspection to ascertain if the said person has corrected his use of the said machine shall be paid by the said person or by his employer to the director for the use of the said station. No holder of a certificate whose authority to manipulate a Babcock or other centrifugal machine has been revoked by the director of the Massachusetts agricultural experiment

station, or by his duly designated deputy, shall thereafter manipulate in this commonwealth any centrifugal machine for the purposes aforesaid.

SECTION 4. The director of the Massachusetts agricultural experiment station and his duly designated deputy are hereby authorized to issue certificates of competency to such persons desiring to manipulate the Babcock or other centrifugal machine as, in the opinion of the director or his deputy, are competent to manipulate said machines. The said director or his deputy may make and enforce rules governing applications for such certificates and the granting thereof and may, in his discretion, revoke the authority of any holder of a certificate who, in the opinion of the director or of his deputy, or of an inspector of the said director, is not correctly manipulating any centrifugal machine as aforesaid, or is using dirty or otherwise unsatisfactory glassware or utensils.

SECTION 5. It shall be the duty of the director of the Massachusetts agricultural experiment station, and he is hereby authorized, to test or cause to be tested all bottles, pipettes and other measuring glasses or utensils submitted to him as provided in section one, to inspect or cause to be inspected at least once each year every Babcock or other centrifugal machine used in this commonwealth by an inspector of milk or cream, or by any person in any milk inspection laboratory, for purposes of inspection, or by any person in any milk depot, creamery, cheese factory, condensed milk factory, or other place for determining the composition or value of milk or cream as a basis for payment in buying or selling, and to collect or cause to be collected for the use of said station the fees or actual cost of tests and inspections provided for in this act. The said director, his inspectors and deputies are further authorized to enter upon any premises in this commonwealth where any centrifugal machine is used as aforesaid to inspect the same and to ascertain if the provisions of this act are complied with.

SECTION 6. Any person hindering or obstructing the director of the Massachusetts agricultural experiment station, or any inspector or deputy of the said director, in the discharge of the authority or duty imposed upon him or them by any provision of this act, and any person violating any of the provisions of sections one, two and three of this act shall be punished by a fine of not less than fifteen and not more than fifty dollars for each offense.

SECTION 7. It shall be the duty of the director of the Massachusetts agricultural experiment station to see that the provisions of this act are complied with, and he may in his discretion prosecute or cause to be prosecuted any person violating any provision of this act. But this act shall not be construed to affect any persons using any centrifugal or other machine or test in determining the composition or value of milk or cream when such determination is made for the information of such persons only, and not for purposes of inspection, or as a basis for payment in buying or selling.

SECTION 8. A sum not exceeding five hundred dollars yearly shall be allowed and paid out of the treasury of the commonwealth to meet the cost of prosecutions under this act, to be paid upon the presentation to the treasurer of the commonwealth by the director of the Massachusetts agricultural experiment station of proper vouchers therefor.

SECTION 9. The word "person" as used in this act shall include a corporation, association or partnership or two or more persons having a joint or common interest.

SECTION 10. Sections sixty-five to sixty-nine, inclusive, of chapter fifty-six of the Revised Laws, and chapter four hundred and twenty-five of the acts of the year nineteen hundred and nine are hereby repealed.

SECTION 11. This act shall take effect on the first day of July in the year nineteen hundred and twelve. [*Approved March 9, 1912.*

Summary of Inspection.

1. *Examination for Certificates.* — Applicants are examined in both theory and practice of the Babcock test. Of those who have applied during the year, 28 candidates were given certificates, while 5 have been refused.

2. *Examination of Glassware.* — Six thousand and fifty-six pieces of Babcock glassware have been tested, of which only 27 pieces were condemned as inaccurate. The amount of untested glassware at present is very small as compared with that found formerly, and confirms the usefulness of the law.

Following is a summary for the twelve years the law has been in force: —

YEAR.	Number of Pieces tested.	Number of Pieces condemned.	Percentage condemned.
1901,	5,041	291	5.77
1902,	2,344	56	2.40
1903,	2,240	57	2.54
1904,	2,026	200	9.87
1905,	1,665	197	11.83
1906,	2,457	763	31.05
1907,	3,082	204	6.62
1908,	2,713	33	1.22
1909,	4,071	43	1.06
1910,	4,047	41	1.01
1911,	4,466	12	.27
1912,	6,056	27	.45
Totals,	40,208	1,924	4.79[1]

[1] Average.

3. *Inspection of Machinery and Apparatus.* — Mr. James T. Howard as deputy inspector has visited and inspected the Bab-

cock machines and apparatus in 80 creameries, milk depots and milk inspectors' laboratories. Nine operators were found using untested glassware, and 15 operators were ordered to repair or replace machines in use. As the law in its application to milk inspectors is new, no prosecutions are being considered at this time; it is believed that all will eventually conform to the law. Following is a list of milk depots, creameries and milk inspectors visited. Only those milk inspectors using the Babcock test are listed.

1. *Creameries.*

Location.	Name.	Manager or Proprietor.
1. Amherst,	Amherst,	R. W. Pease, manager.
2. Amherst,	Fort River,[1]	E. A. King Estate, Proprietors.
3. Ashfield,	Ashfield Co-operative,	Wm. Hunter, manager.
4. Belchertown,	Belchertown Co-operative,	M. G. Ward, manager.
5. Brimfield,	Crystal Brook,	F. N. Lawrence, proprietor.
6. Cummington,	Cummington Co-operative,	D. C. Morey, manager.
7. Egremont,	Egremont Co-operative,	E. A. Tyrell, manager.
8. Easthampton,	Easthampton Co-operative,	W. S. Wilcox, manager.
9. Heath,	Cold Spring,	F. E. Stetson, manager.
10. Hinsdale,	Hinsdale Creamery Company,	Walter Solomon, proprietor.
11. Monterey,	Berkshire Hills,	F. A. Campbell, manager.
12. Northfield,	Northfield Co-operative,	John E. Nye, manager.
13. Shelburne,	Shelburne Co-operative,	I. R. Barnard, manager.
14. Wyben Springs,	Wyben Springs Co-operative,	C. H. Kelso, manager.

[1] Testing done at Massachusetts Agricultural Experiment Station.

2. *Milk Depots.*

Location.	Name.	Manager.
1. Boston,	Boston Condensed Milk Company,	R. Burns.
2. Boston,	Boston Jersey Creamery,	E. F. Luce.
3. Boston,	Elm Farm Milk Company,	J. H. Knapp.
4. Boston,	Franklin Creamery,	O. Bradford.
5. Boston,	H. P. Hood & Sons,	C. H. Hood.
6. Boston,	Oak Grove Farm,	John Alden.
7. Boston,	Plymouth Creamery Company,	R. Gardner.
8. Boston,	Turner Center Dairying Association,	I. L. Smith.
9. Boston,	Walker-Gordon Laboratory,	G. Franklin.

Location.	Name.	Manager.
10. Boston,	D. Whiting & Sons,	George Whiting.
11. Cambridge,	C. Brigham Company,	J. K. Whiting.
12. Cheshire,	Ormsby Farms,	E. B. Penniman.
13. Lawrence,	Crescent Creamery,	E. Morgan.
14. Newburyport,	Newhall's Milk Depot,	John A. Newhall.
15. Pittsfield,	H. H. Prentice & Co.,	H. H. Prentice.
16. Sheffield,	Willow Brook Dairy,	Frank Percy.
17. Southborough,	Deerfoot Farm,	C. H. Newton.
18. Springfield,	Tait Brothers,	H. Tait.

3. *Milk Inspectors.*

Location.	Inspector.	Location.	Inspector.
1. Adams,	A. G. Potter.	26. Newton,	Arthur Hudson.
2. Andover,	F. H. Stacey.	27. New Bedford,	H. B. Hamilton.
3. Amesbury,	E. L. Worthen.	28. North Adams,	H. Tower.
4. Arlington,	L. L. Pierce.	29. Northampton,	G. R. Turner.
5. Barnstable,	Geo. T. Mecarta.	30. Peabody,	H. S. Pomeroy.
6. Boston,	J. O. Jordan.	31. Pittsfield,	E. L. Hannum.
7. Brockton,	G. G. Bolling.	32. Plainville,	John Eiden.
8. Cambridge,	Wm. A. Noonan.	33. Revere,	J. E. Lamb.
9. Chelsea,	W. S. Walkley.	34. South Hadley,	Geo. F. Boudreau.
10. Chicopee,	C. L. O'Brien.	35. Somerville,	H. E. Bowman.
11. Clinton,	G. L. Chase.	36. Springfield,	S. C. Downs.
12. Everett,	E. Clarence Colby.	37. Springfield,	Emerson Laboratory.[1]
13. Fall River,	Henry Boisseau.	38. Taunton,	L. I. Tucker.
14. Fitchburg,	John F. Bresnahan.	39. Wakefield,	J. S. Bonney.
15. Gardner,	C. W. Shippee.	40. Waltham,	Arthur L. Stone.
16. Greenfield,	Geo. P. Moore.	41. Ware,	Fred E. Marsh.
17. Haverhill,	H. L. Conner.	42. Watertown,	L. C. Simmons.
18. Holyoke,	D. P. Hartnett.	43. Wellesley,	F. Schneider, Jr.
19. Lawrence,	J. H. Tobin.	44. Westfield,	W. M. Porter.
20. Lowell,	Melvin Marster.	45. West Springfield,	Norman T. Smith.
21. Ludlow,	A. L. Bennett,	46. Winchendon,	G. W. Stanbridge.
21. Lynn,	H. P. Bennett.	47. Winchester,	Morris Dinneen.
23. Millbury,	F. A. Watkins,	48. Woburn,	E. P. Kelley.
24. Malden,	J. I. Sanford.	49. Worcester,	Gustav L. Berg.
25. Medford,	Winslow Joyce.		

[1] Does work for the State Dairy Bureau.

Water Analysis.

There is no one feature of the home of greater importance than a pure and unfailing water supply. In order that families living where a public supply is not available may have the opportunity of determining the purity of the water from the well or spring they are obliged to use, the experiment station will make a chemical examination of the water at a nominal charge ($3 a sample). Water for examination must be shipped in containers, which will be sent to the applicant on request, and the blank forms sent with the container must be filled out and returned with the sample. A bacteriological examination is not made, and the chemical analysis is limited to those determinations which will indicate sewage contamination or the presence of lead or objectionable metals.

One hundred and ten samples were examined during the past year; of these there were 77 samples from wells, 28 from springs, 4 from ponds and 1 sample of ice. A large number of well waters examined were condemned. Some showed only slight contamination while others were pronounced dangerous for use.

Wells located close to dwellings and stables are particularly liable to contamination; hence great care should be exercised in the location of new wells. Where a well is known to be free from contamination it should be bricked or cemented up well above the surface of the ground in order to prevent the entrance of surface water during wet weather, and the top of the well should be made vermin proof.

Milk, Cream and Feeds for Free Examination.

In addition to the other work of this department, free analyses have been made of 372 samples of milk and 146 samples of feedstuffs. A large number of butter-fat tests on cream by the Babcock method have also been made.

As a general rule, it is preferred to have application made before a sample is submitted for analysis. Directions for proper sampling and for shipping can then be forwarded. An analysis of an improperly drawn sample may lead to erroneous conclusions. In the case of feeding stuffs an analysis is often

unnecessary, as the experiment station has a large amount of analytical data on file which may apply to the sample submitted. This department will not act in the capacity of a commercial chemist, and will use its own discretion in accepting work of this character.

Miscellaneous Work.

In addition to the work already described, this section has conducted investigations, co-operated with other departments, or made analyses as follows: —

1. It has arranged and furnished exhibits and speakers in co-operation with the extension department for fairs, farmers' meetings and expositions.

2. It has co-operated with the Bowker Fertilizer Company in making starch determinations on potatoes in connection with the awarding of prizes.

3. It has co-operated with the agricultural department of the college in making analyses of milk in connection with the awarding of prizes at a dairy show held during "farmers' week."

4. In connection with the experimental work of this and other departments of the experiment station, this section has made analyses of 160 samples of milk, 129 samples of feed and 478 samples of agricultural plants.

Testing Pure-bred Cows.

The work of testing pure-bred cows for entry in the advanced register of the several pure-bred cattle associations continues to increase. During the year, thirteen different men have been used for the Holstein-Friesian work, and for a greater part of the time three men have been employed in the yearly tests for the Guernsey, Jersey and Ayrshire associations. From Dec. 1, 1910, to Dec. 1, 1911, 69 Guernsey, 94 Jersey and 4 Ayrshire tests have been completed. There are now on test 82 Guernseys, 106 Jerseys and 16 Ayrshires, located at 22 different farms. For the Holstein-Friesian Association there have been completed 124 seven-day tests, 7 thirty-day tests, 2 fourteen-day tests and 1 fifty-seven-day test.

The Jersey, Guernsey and Ayrshire clubs are formulating uniform rules for testing, and will probably, in the near future, adopt a one-day monthly test instead of the two-day test now in use.

4. Numerical Summary of Substances examined in the Chemical Laboratory.

The following substances have been received and examined: 110 samples of water, 372 of milk, 2,618 of cream, 146 feed-stuffs, 200 fertilizers and fertilizer refuse materials, 40 soils, 13 lime products, 8 ash analyses of plants and 2 miscellaneous. There have also been examined in connection with experiments in progress by the several departments of the station, 160 samples of milk and cream, 129 cattle feeds and 478 agricultural plants. In connection with the control work there have been collected 1,180 samples of fertilizer and 902 samples of feed-stuffs. The total for the year was 6,359.

The above does not include the work of the research section. In addition, 28 candidates have passed the examination and secured certificates to operate the Babcock test, and 6,056 pieces of Babcock glassware have been tested for accuracy, of which only 27 pieces, or .45 of 1 per cent., were condemned as inaccurate.

5. Correspondence.

The number of letters sent during the year approximates 6,500, the data being based upon the number of stamped envelopes used. In addition a large number of circular letters have been mailed as an adjunct to our inspection work. The larger part of the correspondence is devoted to work in connection with the inspection of fertilizers, cattle feeds, dairy apparatus and the testing of pure-bred cows. A considerable amount of time, however, is still given to answering special inquiries made by farmers and others relative to plant and animal feeding, and the composition and value of fertilizers, cattle feeds and milk.

THE FOOD VALUE OF PLAIN AND MOLASSES BEET PULP.

J. B. LINDSEY.

A few years ago [1] the writer published a brief review of the value of beet residues for farm stock. Since this publication two experiments have been made at this station comparing both the plain and molasses pulp (dried) with corn meal for milk production.

Beet pulp is the residue from the manufacture of sugar from sugar beets. After the beets are shredded and the sugar removed with water by the diffusion process, the residue is run through presses to reduce the water content and then put into kilns and thoroughly dried. The dried plain pulp is coarse and of a gray color. Molasses beet pulp is the pressed plain pulp mixed with the residuum beet molasses and dried. Another method of making the molasses pulp is to mix a definite amount of molasses with the dried pulp. It is understood that but little molasses pulp is now being made.

Composition of the Beet Pulp.

	Plain Pulp.	Molasses Pulp.	Corn Meal [2] for Comparison.	
Water,	9.08	8.48	14.99	15.60
Ash,	3.02	6.93	.86	.85
Protein,	8.90	11.16	7.88	7.82
Fiber,	18.76	10.16	.81	.80
Extract matter,	60.59	62.76	69.76	69.27
Fat,	.65	.51	5.70	5.66
Totals,	100 00	100.00	100.00	100.00

It will be noted that the plain pulp contained about 9 per cent. of water, a relatively large amount of fiber, and practically no fat. The molasses pulp contained considerably more

[1] Twenty-second report of this station, Part II., pp. 21–27.
[2] Samples used in experiment.

ash, due to the large amount of mineral matter in the molasses. The fiber content was considerably less than that of the plain pulp, due to the replacing of the pulp by the molasses which was without fiber. The amount of molasses added to the pulp appears to vary more or less in different samples.

Both the plain and the molasses pulp are carbohydrate feeds similar to corn meal, being relatively low in protein and high in carbohydrates. The extract matter of the molasses pulp contains considerable sugar, while in the plain pulp there is much less sugar and more of the hemicellulose. The carbohydrates of the corn meal consist largely of starch, while those of the plain beet pulp are made up of a high percentage of fiber together with the hemicellulose and some sugar.

Coefficients of Digestibility of Beet Pulp.

Three single trials were made with each sample of the beet pulp with the following average results: —

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Plain pulp,	75	26	52	83	83	-
Plain pulp,[1]	77	-	51	72	86	-
Molasses pulp,	82	51	61	77	90	-
Molasses pulp,[2]	85	-	64	84	91	-
Average molasses pulp,	83	51	63	80	90	-
Corn meal for comparison,	88	-	67	-	92	90

[1] German experiments.
[2] Three earlier trials.

The coefficients for plain pulp made at this station are reasonably close to those of German origin. The molasses pulp shows higher coefficients than the plain pulp. Part of this is due, however, to the high ash percentage and its increased digestibility.

Pounds of Digestible Organic Matter in a Ton.

	Protein.	Fiber.	Extract Matter.	Fat.	Totals.
Plain pulp,	92.56	311.42	1,005.79	-	1,409.77
Molasses pulp,	140.62	162.56	1,129.68	-	1,432.86
Corn meal for comparison,	105.59	-	1,283.58	101.88	1,491.05

It will be seen from the coefficients that while the dry matter in the molasses pulp has a higher digestibility than that in the plain pulp, and while the dry matter in the corn meal shows an increased digestibility over either of the pulps, the digestibility of the total organic nutrients in *one ton* of the several feeds does not vary widely. This is explained on the ground that the molasses pulp contains noticeably more ash than the plain pulp, and that the corn meal has some 6 per cent. more water than the dried pulps. On the basis of digestible organic nutrients in one ton, it would appear that the corn meal was substantially 5 per cent. more valuable than the average of the two pulps. Calculations made on the basis of net energy value show the corn meal to furnish 20 per cent. more energy than the dried pulp. This is due to the increased energy assumed to be required to digest the fiber contained in the pulp. It is doubtful, however, if the soft beet fiber causes as much energy loss as do the harder fibers of the hays and straw. One may conclude that in practical feeding trials comparatively little difference would be noted, pound for pound, between the two feeds, especially if the amounts of each feed fed did not exceed 5 pounds daily to each animal.

Feeding Experiments with Cows.

1. *Plain Pulp* v. *Corn Meal.*

Six cows were fed by the reversal method in periods lasting five weeks.

History of Cows.

Cows.	Breed.	Age (Years).	Last Calf dropped.	Yield of Milk at Beginning of Experiment (Pounds).
Amy,	Pure Jersey,	2	September 18,	14.8
Betty,	Grade Jersey,	5	September 21,	20.8
Cecile,	Pure Jersey,	4	October 23,	27.6
Fancy II.,	Grade Jersey,	2	September 30,	14.6
Daisy,	Grade Jersey,	11	October 9,	21.5
Gladys,	Pure Jersey,	6	October 10,	22.7

Duration of Experiment.

Dates.	Cows.		Length of Period (Weeks).
	Plain Beet Pulp.	Corn Meal.	
December 4 through January 7, .	Amy, Betty, Cecile,	Fancy II., Daisy, Gladys.	5
January 14 through February 18, .	Fancy II., Daisy, Gladys.	Amy, Betty, Cecile,	5

The method of caring for, feeding and weighing the animals, of sampling the feeds and milk, was the same as described under the oat *v.* corn meal experiment published elsewhere in this report. The milk was sampled for five consecutive days on the first, third and fifth week of the experiment.

Character of Feeds. — The hay was early cut and well cured, being an admixture of Kentucky blue grass with some clover and sweet vernal grass. The corn meal and spring bran were of good average quality. Cottonseed meal was of good color, but rather below the average in protein. The plain beet pulp was of normal character.

Total Feeds consumed by Each Cow (Pounds).

Corn Meal Ration.

Cows.	Hay.	Bran.	Corn Meal.	Cotton-seed Meal.	Beet Pulp.
Amy, ...	546	70	105	35	-
Betty, ...	629	70	175	18	-
Cecile, ...	663	70	175	28	-
Daisy, ...	630	72	175	18	-
Fancy II., ...	490	70	105	-	-
Gladys, ...	630	70	175	18	-
Totals, ...	3,588	422	910	117	-

Beet Pulp Ration.

Cows.	Hay.	Bran.	Corn Meal.	Cotton-seed Meal.	Beet Pulp.
Amy, ...	477	70	-	35	105
Betty, ...	625	70	-	18	175
Cecile, ...	663	70	-	35	175
Daisy, ...	628	70	-	18	175
Fancy II., ...	546	68	-	-	99
Gladys, ...	628	70	-	18	175
Totals, ...	3,567	418	-	124	904

Average Daily Ration consumed by Each Cow (Pounds).

Character of Ration.	Hay.	Bran.	Corn Meal.	Cotton-seed Meal.	Beet Pulp.
Corn meal,	17.09	2.01	4.33	.67	-
Beet pulp,	16.99	1.99	-	.71	4.30

It will be seen that the different cows were fed somewhat different amounts of the several feedstuffs, depending upon their individual needs. The basal ration consisted of hay, bran and cottonseed meal to which were added an average of 4.3 pounds of corn meal or beet pulp daily. A slight error occurred in that 3.91 pounds of dry matter were fed in the form of beet pulp as against 3.70 in case of corn meal, due, of course, to the higher moisture content of the meal.

Dry Matter and Digestible Organic Nutrients in Average Daily Rations (Pounds).

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.[1]	
Corn meal,	21.12	1.57	2.96	8.17	.53	13.87	1:7.83
Dried beet pulp,	21.29	1.54	3.53	7.60	.32	13.37	1:7.68
Haecker Standard.[2]							
Corn meal,	-	1.59	-	10.66	.46	13.26	1:7.34
Dried pulp,	-	1.60	-	10.70	.46	13.31	1:7.32
Savage Standard.[3]							
Corn meal,	-	1.97	-	-	-	14.02	1:6.12
Dried pulp,	-	1.97	-	-	-	14.07	1:6.14

[1] Including fat multiplied by 2.2.
[2] Bulletin No. 79, Minnesota Experiment Station.
[3] Bulletin No. 323, Cornell Experiment Station.

The data in the first subdivision indicate the amounts of digestible nutrients contained in the feeds actually fed. The corn meal ration contained .5 pound of total nutrients in excess

of the dried beet pulp ration. The nutrients in the two rations fed agree quite closely with the Haecker standard. The Haecker standard as modified recently by Savage calls for both more protein and more total nutrients. It would probably have been advisable in case of our experiment to have reduced the basal ration of hay, bran and cottonseed meal a little in order to have secured a more pronounced effect — if any — of the corn meal and plain beet pulp. On the basis of digestible nutrients actually consumed, one would not expect much difference in the milk yield.

Herd Gain or Loss in Live Weight (Pounds).

Corn meal ration, ...	33—
Beet pulp ration, ...	37+

A slight difference in favor of the pulp was noted.

Yield of Milk and Milk Ingredients (Pounds).

Corn Meal.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (1/6 added).
Amy, ...	508.2	14.5	78.26	30.75	35.88
Betty, ...	714.1	20.4	103.33	38.20	44.57
Cecile, ...	901.5	25.8	127.65	46.34	54.06
Daisy, ...	639.4	18.3	98.21	37.34	43.56
Fancy II., ...	454.8	13.0	62.22	22.06	25.73
Gladys, ...	723.3	20.7	105.02	40.58	47.34
Totals, ...	3,941.3	18.8[1]	574.69	215.27	251.14

Beet Pulp.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (1/6 added).
Amy, ...	482.6	13.8	72.78	28.14	32.83
Betty, ...	699.6	20.0	102.07	36.87	43.02
Cecile, ...	856.2	24.5	121.75	43.15	50.34
Daisy, ...	718.4	20.5	109.34	41.74	48.70
Fancy II., ...	482.5	13.8	65.48	22.97	26.80
Gladys, ...	777.8	22.2	112.86	43.63	50.90
Totals, ...	4,017.1	19.1[1]	584.28	216.50	252.59

[1] Average.

The above results show no striking variations in the yields. The beet pulp ration produced substantially 2 per cent. more milk and milk solids than did the corn meal ration. This is within the limit of error. It may have been due partly to the superior mechanical effect of the pulp, although this is pure assumption.

Average Composition of the Herd Milk.

Character of Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
Corn meal,	14.58	5.46	9.12
Beet pulp,	14.54	5.39	9.15

Differences in the composition of the milk are not noted.

Food Cost of Milk and Butter.

Character of Ration.	Total Milk.	100 Pounds Milk.	1 quart Milk (Cents).	1 Pound Butter (Cents).
Corn meal,	$50 80	$1 29	2.90	17.9
Beet pulp,	47 89	1 22	2.85	16.6

The beet pulp cost some $6 a ton less than the corn meal at the time the experiment was in progress; hence the cost of the milk produced was also less (some 6 per cent.).

Dry and Digestible Matter required to produce Milk and Milk Ingredients (Pounds).

Character of Ration.	Dry Matter.			Digestible Nutrients.		
	100 Pounds Milk.	1 Pound Solids.	1 Pound Fat.	100 Pounds Milk.	1 Pound Solids.	1 Pound Fat.
Corn meal,	112.00	7.68	20.51	70.17	4.81	12.85
Beet pulp,	110.72	7.61	20.54	67.54	4.64	12.53

The above figures include the food material required for maintenance. They show that a little less dry and digestible organic nutrients were required to produce like amounts of milk and milk ingredients with the beet pulp than with the corn meal ration.

2. *Molasses Beet Pulp* v. *Corn Meal.*

This trial followed directly after the one with plain beet pulp already described. The same cows were used.

Duration of Experiment.

Dates.	Cows.		Length of Period (Weeks).
	Corn Meal.	Molasses Beet Pulp.	
February 26 through April 1,	Amy, Betty, Cecile,	Daisy, Fancy II., Gladys.	5
April 8 through May 13,	Daisy, Fancy II., Gladys.	Amy, Betty, Cecile,	5

Total Feeds consumed by Each Cow (Pounds).

Corn Meal Ration.

Cows.	Hay.	Bran.	Cotton-seed Meal.	Corn Meal.	Molasses Beet Pulp.
Amy,	487	70	35	105	-
Betty,	622	70	18	175	-
Cecile,	660	70	28	175	-
Daisy,	628	70	18	175	-
Fancy II.,	474	70	-	105	-
Gladys,	630	70	18	175	-
Totals,	3,501	420	117	910	-

Molasses Beet Pulp Ration.

Cows.	Hay.	Bran.	Cotton-seed Meal.	Corn Meal.	Molasses Beet Pulp.
Amy,	490	70	35	-	105
Betty,	628	70	18	-	175
Cecile,	665	70	35	-	175
Daisy,	627	73	18	-	175
Fancy II.,	398	70	-	-	105
Gladys,	630	70	18	-	175
Totals,	3,438	423	124	-	910

Average Daily Ration consumed by Each Cow (Pounds).

Character of Ration.	Hay.	Bran.	Cotton-seed Meal.	Corn Meal.	Molasses Beet Pulp.
Corn meal,	16.67	2.00	.67	4.33	-
Molasses beet pulp,	16.37	2.01	.71	-	4.33

The cows consumed slightly less hay during the molasses beet pulp half of the trial. It will be noted that hay, bran and cottonseed meal constituted the basal ration, and that 4.33 pounds of corn meal were compared with a like amount of beet pulp.

Dry Matter and Digestible Organic Nutrients in Average Daily Rations (Pounds)

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.[1]	
Corn meal,	20.90	1.50	2.83	8.22	.53	13.72	1:8.15
Molasses beet pulp,	20.98	1.59	3.15	7.86	.32	13.30	1:7.36
Haecker Standard.[2]							
Corn meal,	–	1.68	–	11.17[3]	.48	13.92	1:7.29
Molasses beet pulp,	–	1.61	–	10.68	.46	13.30	1:7.26
Savage Standard.[2]							
Corn meal,	–	2.08	–	–	–	14.73	1:6.08
Molasses beet pulp,	–	1.99	–	–	–	14.07	1:6.07

[1] Including fat multiplied by 2.2.
[2] Already cited.
[3] Fiber included.

It appears that the two rations contained substantially equal amounts of total digestible nutrients and ought to produce about the same amount of milk. The molasses pulp ration contained rather more fiber, but the excess being derived from beet pulp should not have required much more energy for its digestion than the extract matter. These nutrients fed correspond quite closely to the Haecker standard as stated above. They are not quite as liberal as those recently suggested by Savage. If the basal ration of hay, bran and cottonseed meal fed had been a little less, it would have brought out a trifle more sharply the difference — if any — in feeding value between the corn meal and the molasses pulp.

Herd Gain or Loss in Live Weight (Pounds).

Corn meal ration,	109+
Molasses beet pulp ration,	90+

A slight gain occurred on both rations, indicating that the animals were advancing in lactation and not devoting as much of their food to milk as in the former experiment.

Yield of Milk and Milk Ingredients (Pounds).

Corn Meal.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (1/6 added).
Amy,	595.6	17.0	90.83	35.74	41.70
Betty,	821.5	23.6	120.46	44.28	51.66
Cecile,	984.9	28.1	143.20	53.28	62.16
Daisy,	682.1	19.5	103.98	41.06	47.90
Fancy II.,	370.3	10.6	50.81	18.11	21.13
Gladys,	726.6	20.8	104.49	40.90	47.72
Totals,	4,184.0	19.9[1]	613.77	233.37	272.27

Molasses Beet Pulp.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent (1/6 added).
Amy,	481.6	13.8	72.09	28.27	32.98
Betty,	647.5	18.5	93.37	33.22	38.76
Cecile,	763.9	21.8	109.77	39.88	46.53
Daisy,	797.5	22.8	116.59	45.30	52.85
Fancy II.,	496.8	14.2	71.24	25.59	29.86
Gladys,	867.1	24.8	125.56	48.30	56.35
Totals,	4,054.4	19.3[1]	588.62	220.56	257.33

[1] Average.

The herd produced some 3 per cent. less milk and 4 per cent. less solids while on the molasses pulp ration. Such results will have to be considered substantially within the limit of error. At least, no wide difference in yield is noted.

Average Composition of the Herd Milk.

Character of Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
Corn meal,	14.67	5.58	9.09
Molasses beet pulp,	14.52	5.44	9.08

The milk produced with the pulp ration appears to be slightly lower in fat than that produced by the corn meal ration. The difference is not marked and much emphasis cannot be placed upon it.

Food Cost of Milk and Butter.

Character of Ration.	Total Milk.	100 Pounds Milk.	1 quart Milk (Cents).	1 Pound Butter (Cents).
Corn meal,	$50 08	$1 19	2.68	16.1
Molasses beet pulp,	47 46	1 17	2.63	16.1

The milk produced by the beet pulp ration cost a little less because the pulp at the time could be purchased for noticeably less money per ton than the corn meal.

Dry and Digestible Matter required to Produce Milk and Milk Ingredients (Pounds).

Character of Ration.	Dry Matter.			Digestible Nutrients.		
	100 Pounds Milk.	1 Pound Solids.	1 Pound Fat.	100 Pounds Milk.	1 Pound Solids.	1 Pound Fat.
Corn meal,	104.40	7.12	18.72	65.35	4.45	11.72
Molasses beet pulp,	108.10	7.45	19.87	66.56	4.58	12.23

The results are slightly in favor of the corn meal ration.

General Conclusions.

1. On the basis of dry matter the plain and molasses beet pulps contain substantially equal quantities of digestible organic nutrients; on the same basis corn meal has about 13 per cent. more digestible nutrients.

2. On a natural moisture basis (9 per cent. for the pulps and 15 per cent. for the corn meal) corn meal has about 5 per cent. more digestible organic nutrients than the dried beet pulps.

3. The results of the two feeding trials reported show that the rations containing the beet pulp produced substantially as much milk as those containing corn meal.

The Place of Dried Beet Residues in the Farm Economy.

Farmers who are in a position to produce their own feed cannot afford, as a rule, to purchase starchy feedstuffs; they should be produced upon the farm, in the form of corn, oats and barley. For milk production it is much more desirable to purchase materials rich in protein, such as cottonseed and linseed meals, dried distillers' and brewers' grains, gluten feed, malt sprouts, fine middlings and even bran. These feedstuffs are not only very helpful in milk production, but likewise supply large amounts of nitrogen in the resulting manure. When the supply of home-grown corn is exhausted or limited, beet residues may be substituted for fattening stock and as one-third of the grain ration for dairy purposes. Milk producers who purchase all of their grain will find the dried pulp a satisfactory component (one-third to one-half) of the daily ration. It can also be fed, in amounts of from 8 to 10 pounds of dried pulp daily, as a partial substitute for roughage. It should be mixed with two to three times its weight of water.

THE VALUE OF OATS FOR MILK PRODUCTION.

J. B. LINDSEY.

Oats are held in high esteem as a food for all classes of farm animals, and particularly for horses. They are also regarded as a valuable food for milk production, although their relative cost, especially in the east, has prevented their use for this purpose. For example, the average wholesale price for a ton of oats in 1910 was $29.51, and for the first eight months of 1911 it was $26.99, as against $26.39 and $23.88 for corn meal.

The fact that oats are so highly regarded for the production of milk led the station to conduct three demonstration experiments with dairy cows, comparing ground oats with a like amount of corn meal.

THE COMPOSITION OF OATS (PER CENT.).

	Oats fed.	Average American Analyses.[1]	Average Foreign Analyses.[2]	Corn Meal fed.	Corn Meal. Average Massachusetts Analyses.[3]
Water,	10.80	10.40	13.30	14.50	11.00
Ash,	3.25	3.20	3.10	.86	1.30
Protein,	12.15	11.40	10.30	7.93	9.80
Fat,	4.41	4.80	4.80	5.74	3.90
Fiber,	8.94	10.80	10.30	.81	2.00
Extract matter,	60.45	59.40	58.20	70.16	72.00
	100.00	100.00	100.00	100.00	100.00

[1] Henry, 1910.
[2] Kellner, 1909.
[3] Lindsey's Compilation, 1910.

Oats vary in composition rather more than some other cereals. The larger the percentage of hulls the lower the percentages of

protein and fat. Oats that are imperfectly developed are likely to have relatively more protein and less starchy matter than those that have been well formed. The percentage of hulls varies between 20 and 35, with a probable average of 26. It was held formerly that oats contained an alkaloid avenin which accounted for their peculiar effect in imparting spirit to horses, but more recent investigations have failed to identify this product. E. Schulze identified an alkaloid Trigonellum in the oat, but the amount found was so small as to be without influence as a stimulant.

The corn meal fed in the present experiment was the usual material now offered in the general markets. It evidently was not ground corn kernels, but a sifted product resulting from the manufacture of cracked corn. The analysis of corn meal given for comparison represented the average of 119 samples of ground corn kernels. It is higher in protein and fiber and lower in fat than the sifted product.

Oats differ from corn in having noticeably more ash, rather more protein and decidedly more fiber.

The Digestibility of Oats.

The coefficients of digestibility were not determined in the particular sample fed. Here follow the average coefficients obtained for American and German oats: —

	American.[1]	Foreign.[2]	Corn Meal for Comparison.
Dry matter,	70	70	88
Ash,	25	-	67
Protein,	77	76	-
Fiber,	31	26	-
Extract matter,	77	76	92
Fat,	89	80	90

[1] Lindsey. [2] Kellner.

Applying the above coefficients to the average composition of American and foreign oats, and to the average analysis for corn

meal, we have the following amounts of digestible matter in 100 pounds: —

	American Oats.	Foreign Oats.	American Corn Meal.
Protein,	8.78	7.83	6.57
Fiber,	3.35	2.68	-
Fat,	4.27	3.84	3.51
Extract matter,	45.74	44.23	66.24
Total,	62.14	58.58	76.32

One hundred pounds of corn contains, therefore, some 16 pounds, or 27 per cent., more digestible material than a like amount of oats.

Kellner placed the net energy value of corn at 81.5, and of oats at 59.7, or as 100 is to 73.2 (starch equivalents). One would, therefore, assume that for the ordinary purposes of nutrition oats were substantially one-fourth less valuable than corn. This does not take into account the favorable mechanical or special energy effects of oats. The nutritive inferiority of oats is due to the large percentage of indigestible hull. The oat kernel free from hull is easily and highly digestible.

Feeding Experiments with Oats for Milk Production.

The object of the experiments was to compare a definite amount of oats with a like amount of corn meal (*a*) upon the general condition and weight of each animal and (*b*) upon the yield of milk, milk solids and fat.

The plan of the experiments consisted in taking four cows, all of which were fresh in late summer, and dividing them into two groups of two each. In the first half of the trial two of the cows received the so-called oat ration at the same time the other two cows were receiving the corn meal ration. In the second half of the trial the rations were reversed. The experiment was carried out three times.

History of the Cows, 1909–10.

Cows.	Breed.	Age (Years).	Last Calf dropped.	Yield of Milk at Beginning of Period (Pounds).
Samantha, ...	Grade Holstein, .	6	August 18,	27.2
Minnie, ...	Grade Holstein, .	6	August 26,	25.8
Ida, ...	Pure Jersey, . .	2	August 19,	19.3
Red III., ...	Grade Jersey, . .	4	September 3,	27.6
May Rio, ...	Pure Jersey, . .	7	November 11,	24.2

The first four cows were used in Experiments I. and II.; cow May Rio was substituted for Minnie in Experiment III.

Duration of the Three Experiments, 1909–10.

Experiment I.

Dates.	Cows.	Ration.
October 16, through November 12, .	Minnie and Samantha	Corn meal.
	Red III. and Ida.	Ground oats.
November 20, through December 17, .	Red III. and Ida.	Corn meal.
	Minnie and Samantha.	Ground oats.

Experiment II.

December 25, through January 21, .	Minnie and Samantha	Corn meal.
	Red III. and Ida.	Ground oats.
January 29, through February 25, .	Red III. and Ida.	Corn meal.
	Minnie and Samantha.	Ground oats.

Experiment III.

March 4, through April 1, . . .	Samantha and Red III.	Corn meal.
	Ida and May Rio.	Ground oats.
April 9, through May 6, . . .	Ida and May Rio.	Corn meal.
	Samantha and Red III.	Ground oats.

It will be seen that each period lasted twenty-eight days with an interval of seven days between each experiment and each half.

General Care, Feeding and Weighing. — The cows were kept in roomy stalls, carded daily, and turned into the barnyard for from four to six hours each pleasant day. The daily feed was given in two portions, and water was kept continuously before each animal. All the cows were in good condition at the beginning of the trial.

Each animal was weighed for three consecutive days at the beginning and end of each half of the trial. The weighing was done in the afternoon as the cows were brought in from the yard, previous to feeding and watering.

Sampling Feeds and Milk. — The hay was sampled at the beginning, middle and end of each half of the trial. This was accomplished by taking forkfuls here and there from the day's feeding and running them through a cutter. The cut hay was mixed, subsampled, and the final sample placed in a glass-stoppered bottle and brought to the laboratory at once for a dry-matter test. An aliquot of each of the several samples of hay was mixed and analyzed. The bran, ground oats and corn meal were sampled by taking a like amount daily and placing in glass-stoppered bottles. At the end of each half of the trial a dry-matter determination was made, and at the end of three trials an aliquot of each sample was mixed and analyzed. The milk of each cow was sampled twice daily for five consecutive days on the second and fourth week of each half of the trial, preserved in glass-stoppered bottles with the aid of formalin and tested for solids and fat. The method of sampling consisted in mixing the freshly drawn milk with an especially constructed mixer, and immediately removing a definite amount with a long-handled small dipper.

Character of Feeds. — Hay, fine and early cured, largely Kentucky blue grass with more or less clover and sweet vernal grass. Ground oats, corn meal and bran of average quality.

Total Feeds consumed (Pounds).

Experiment I.

	Corn Meal Ration.			Oat Ration.		
	Hay.	Bran.	Corn Meal.	Hay.	Bran.	Oats.
Minnie,	560	84	112	558	84	112
Samantha,	644	112	140	642	112	140
Red III.,	559	84	140	560	84	140
Ida,	501	84	112	510	81	108
Totals,	2,265	364	504	2,274	361	500
Average per cow daily,	20.22	3.25	4.5	20.30	3.22	4.46

Experiment II.

	Hay.	Bran.	Corn Meal.	Hay.	Bran.	Oats.
Minnie,	544	84	112	478	84	112
Samantha,	630	112	140	554	112	140
Red III.,	553	84	140	560	84	140
Ida,	435	84	112	477	81	108
Totals,	2,162	364	504	2,069	361	500
Average per cow daily,	18.41	3.25	4.5	18.47	3.22	4.46

Experiment III.

	Hay.	Bran.	Corn Meal.	Hay.	Bran.	Oats.
Samantha,	544	84	140	559	84	140
Red III.,	531	84	140	503	84	140
Ida,	448	84	112	445	84	112
May Rio,	560	84	112	553	84	112
Totals,	2,083	336	504	2,060	336	504
Average per cow daily,	18.60	3.00	4.50	18.39	3.00	4.50

It will be seen from the footings and averages of the above tables that the average basal ration in each half of each experiment consisted of like amounts of hay and bran, to which were added like amounts of either corn meal or ground oats. Hence a definite amount of corn meal was compared with a like amount of ground oats.

In the first experiment the dry matter in the corn meal and in the oats showed comparatively slight variation. In the second experiment, however, the corn meal averaged 85.37 per

cent. and the oats 90.78 per cent. of dry matter, so that 3.84 pounds of dry matter in corn meal were fed against 4.05 pounds in oats. In case of the third experiment 3.8 pounds of dry matter in corn were fed against 4.02 pounds of dry matter in oats. This matter was overlooked at the time, but should have been guarded against by feeding slightly more corn meal. The difference, however, while in favor of the oats was not so great as to have caused a marked effect upon the yields of milk, and would be more than offset by the variations in the hay consumed by the several animals as indicated in the above tables.

Dry and Digestible Matter in Daily Rations (Pounds).

Experiment I.

Character of Ration.	Average Weight per Cow.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
			Protein.	Fiber.	Extract Matter.	Fat.	Total.	
Corn meal, . .	877	24.64	1.63	3.40	9.63	.57	15.23	1: 8.76
Oat, ...	891	24.70	1.81	3.53	8.74	.52	14.60	1: 7.41

Experiment II.

Character of Ration.	Average Weight per Cow.	Dry Matter.	Protein.	Fiber.	Extract Matter.	Fat.	Total.	Nutritive Ratio.
Corn meal, . .	901	23.77	1.64	3.46	9.06	.56	14.73	1: 8.39
Oat, ...	897	23.22	1.79	3.44	8.05	.49	13.76	1: 7.02

Experiment III.

Character of Ration.	Average Weight per Cow.	Dry Matter.	Protein.	Fiber.	Extract Matter.	Fat.	Total.	Nutritive Ratio.
Corn meal, . .	863	23.09	1.54	3.27	8.91	.56	14.27	1: 8.71
Oat, ...	880	23.12	1.72	3.36	8.08	.50	13.66	1: 7.29

The total dry matter fed in the first experiment was practically identical for each ration. In the second experiment the cows averaged .55 pound more dry matter per day on the corn meal ration. This was due to the fact that cows Minnie and Samantha ate more hay while receiving the corn meal. In the third experiment the amounts of total dry matter consumed were about the same. The average amount of digestible organic matter received by each cow was from about .6 to 1 pound less per day on the oat ration, due generally to the less digestible matter in the oats, and in case of the second experiment to the less hay eaten by the two cows mentioned.

The corn ration had a wider nutritive ratio than the oat ration, due to the less protein and more carbohydrate material in the corn.

Gain or Loss in Live Weight (Pounds).

Character of Ration.	Experiment I.	Experiment II.	Experiment III.	Total Gain.
Corn meal, ...	69+	36+	57+	162
Oat, ...	85+	24−	75+	136

The above figures indicate that a gradual gain in live weight took place, particularly during the first and third experiments. In the second experiment the gain was not so noticeable and, in fact, the animals lost slightly on the oat ration. One notes, however, no particular influence of one ration over the other.

Yield of Milk and Milk Ingredients (Pounds).

Character of Ration.	Total Milk.	If Corn Ration equals 100, Oat Ration equals —	Total Solids.	Total Fat.
Experiment I.				
Corn meal, ...	2,293.4	-	325.3	125.3
Oat, ...	2,146.3	93.6	302.3	118.5
Experiment II.				
Corn meal, ...	1,991.7	-	294.3	115.1
Oat, ...	2,014.2	101.2	295.1	115.6
Experiment III.				
Corn meal, ...	2,150.1	-	316.3	127.5
Oat, ...	2,234.1	104.0	324.9	131.8
Average.				
Corn meal, ...	2,148.4	-	312.0	122.5
Oat, ...	2,131.5	99.0	307.0	122.0

In the second and third experiments the yields of milk and milk ingredients were nearly identical; at least, no marked variations were noted. In the first experiment the corn meal

ration apparently produced the larger yield. This, however, was due in a large measure to the fact that the cow Minnie injured a teat shortly after starting in on the oat ration, and her milk yield fell some 5 pounds per day. The most that can be said is that an average of the three trials shows the two rations to have produced substantially like results. This was at first thought hardly to be expected, for the reason that the oats contain some 30 per cent. of hull, and, other things being equal, are rated as having an inferior feeding value to the corn. It is believed that the experiments were not conducted in such a way as to bring out sharply the difference in the value of the two feeds. The animals were evidently receiving an excess of nourishment, so that the mere difference in the nutritive value between 5 pounds of corn and oats was of no particular moment. If the amount of hay and bran (basal ration) fed had been noticeably less, so that the animals would have received in addition to their maintenance requirements perhaps three-fourths of the amount of food necessary for their normal milk yield, the addition of the corn meal or oats would have given a sharper indication of their respective nutritive values.

On the basis of the method suggested by Armsby,[1] allowing .5 pound of protein and 6 therms of energy for maintenance, .05 pound of protein and .3 therm of energy per pound of 4 per cent. milk, the average cow in the three experiments required and received as follows: —

Required.

Character of Ration.	Average Weight of Cow (Pounds).	Average Milk Yield per Cow (Pounds).	Protein (Pounds).	Energy in Therms.
Corn meal,	880	19.2	1.40	11.10
Oat,	890	19.0	1.39	11.00

Received.

Corn meal,	880	19.2	1.60	12.42
Oat,	890	19.0	1.77	11.80

[1] Farmers' Bulletin No. 346, p. 16.

The required nutrients were figured on the basis of average milk testing 4 per cent., while the average milk produced by the cows under test was 5.71 per cent. fat. Such milk would naturally require more nutrients for its production, but we have no exact method at present on which to base a calculation for milk of different degrees of richness. On the basis of the above calculations it will be seen that both the rations fed were in excess of those required, which, as above explained, would account for the lack of any particular difference in feeding effect.

The amount of digestible nutrients consumed by the *average cow,* and the amount required by Haecker's standard, was as follows: —

Nutrients consumed (Pounds).

Character of Ration.	Protein.	Carbohydrates, and Fat multiplied by 2.2.	Total.
Corn meal,	1.60	13.82	15.42
Oat,	1.77	12.84	14.61

Haecker Standard.

Corn meal,	1.74	12.37	14.11
Oat,	1.74	12.39	14.13

It will be seen that the digestible nutrients fed in each case were noticeably above what was required.

All of the above evidence goes to show that in case of both rations the cows received more than was actually needed, which, in itself, is a reasonable explanation of why the corn did not show itself superior in nutritive effect to the oats.

Average Composition of the Herd Milk.

Experiment I.

Character of Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).
Corn meal,	14.18	5.46
Oat,	14.09	5.52

Average Composition of the Herd Milk — Concluded.

Experiment II.

Character of Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).
Corn meal,	14.78	5.78
Oat,	14.65	5.74

Experiment III.

Corn meal,	14.71	5.93
Oat,	14.54	5.90

Net Amount of Dry and Digestible Organic Matter Required to produce Milk, Milk Solids and Fat.[1]

Experiment I.

	100 Pounds Milk.		1 Pound Solids.		1 Pound Fat.	
	Corn Ration.	Oat Ration.	Corn Ration.	Oat Ration.	Corn Ration.	Oat Ration.
Dry matter,	68.65	71.84	4.77	5.10	12.44	13.25
Digestible organic matter,	41.55	39.91	2.89	2.83	7.52	7.35

[1] Excluding food of maintenance.

Experiment II.

Dry matter,	71.19	68.32	4.80	4.62	12.46	11.86
Digestible organic matter,	43.24	37.84	2.91	2.56	7.55	6.55

Experiment III.

Dry matter,	65.33	62.25	4.39	4.23	10.87	10.41
Digestible organic matter,	39.54	34.36	2.66	2.33	6.58	5.74

Average.

Dry matter,	68.39	67.47	4.65	4.65	11.92	11.84
Digestible organic matter,	41.44	37.37	2.82	2.57	7.22	6.55

The above was calculated on the basis of Haecker's data, allowing 1.25 pounds of dry matter and .792 pound of digestible organic matter per 100 pounds live weight for maintenance.

The amount of total dry and digestible matter consumed was secured from our dry-matter determinations and analyses and the use of average digestion coefficients. They tell substantially the same story as did the yields of milk and milk ingredients. In the first experiment it required rather more dry matter to produce a definite amount of milk and milk ingredients with the oat ration. In all of the experiments a definite amount of milk and milk ingredients was produced by a little less digestible matter derived from the oat ration. The average of the three trials shows milk and milk ingredients were produced by the use of rather less dry and digestible matter for the oat ration. The reason for this has already been indicated.

Food Cost of Milk and Butter-fat.

Character of Ration.	Total Milk.	100 Pounds Milk.	1 Quart Milk (Cents).	1 Pound Fat (Cents).
Experiment I.				
Corn meal,	$30 91	$1 35	3.04	24.7
Oat,	32 26	1 50	3.38	27.2
Experiment II.				
Corn meal,	$30 09	$1 51	3.40	26.1
Oat,	30 62	1 52	3.42	26.5
Experiment III.				
Corn meal,	$29 07	$1 35	3.04	22.8
Oat,	30 30	1 36	3.06	23.0
Average.				
Corn meal,	$30 02	$1 40	3.16	24.5
Oat,	31 06	1 46	3.29	25.6

In the first experiment the milk cost noticeably less on the corn ration; in the second experiment the results were about equal; and in the third experiment the corn ration had a slight advantage. The average of the three experiments is slightly in favor of the corn ration. The reason for sharper difference

between the influence of the two rations has already been explained. In this experiment hay was figured at $16, corn meal at $32, oats at $37.50 and bran at $26 a ton.

Conclusions.

1. Chemical analysis and digestion tests indicate that oats have about one-fourth less actual nutritive value than corn (on basis of equal parts of dry matter).

2. The three comparative experiments conducted with dairy cows indicated that the oat ration produced practically as much milk and butter as did the corn ration, but at 3½ per cent. greater cost.

3. The reason why the difference in the nutritive effect of the two grains was not more sharply brought out probably lies in the fact that the experiments themselves were not correctly planned. The nutritive material in the total oat ration was sufficient to enable the cows to do good if not maximum work, and the increased nutritive material in the corn ration was not necessary and had, therefore, no pronounced effect. The basal ration (*i.e.*, without the corn or oats) should have been less in amount and then the results obtained from the addition of corn and oats would have been more pronounced.

4. Many experiments to compare the practical feeding values of different feedstuffs do not return the results desired, for the reason that they are not planned in a way to eliminate all but the one point to be demonstrated. In fact, it is not believed that experiments of this character can tell as true a story as investigations resulting from analysis, digestibility and respiration experiments, when the net energy values of the several feedstuffs can be fairly accurately ascertained. Experiments however, of the sort here described are useful in giving one a general idea of the relative merits of different feeding stuffs, but care should be taken to keep the basal ration considerably below the amount of food needed, so that when the feeds to be studied are added the total ration will still be a little below the amount required by the animal for an average production.

5. While oats are a valuable food, it is not believed they can usually be fed economically to dairy animals in Massachusetts.

SOME EFFECTS OF FERTILIZERS ON THE GROWTH AND COMPOSITION OF ASPARAGUS ROOTS.

FRED W. MORSE.

A series of fertilizer experiments on asparagus was planned in 1906 by Director Brooks, to ascertain the efficiency of different methods of manuring this crop. The field is located on the farm of Mr. C. W. Prescott in Concord, and its soil is like that of most asparagus fields, a sandy loam of little natural fertility.

In January, 1910, the writer was assigned the task of ascertaining the specific effects of the three principal chemical fertilizers used in the experiment — nitrate of soda, acid phosphate and muriate of potash — on the chemical composition of the crop, as such effects would be important factors in determining the relative efficiency of the fertilizers.

This paper will deal with the effects of the fertilizers upon the roots of the asparagus plants, a matter about which little has been reported by other workers.

Rousseaux and Brioux made a partial analysis of the roots as a minor part of an elaborate research on the asparagus crop published in 1906.[1]

Tanret has made an extended study of the properties of the carbohydrates contained in the roots.[2]

Wichers and Tollens have reported very complete analyses of roots collected before and after the cropping season.[3]

The material studied by the writer consisted of the entire underground portion of the asparagus plant, except the fine, fibrous feeding-rootlets which were removed, as it was impossible to collect any reasonable proportion of them.

No effort was made to separate the crown or center of the

[1] Annales de la Science Agronomique, 3d Series, I., pp. 189–326 (1906).

[2] Bulletin de Soc. Chim. (4) V., pp. 889–893 (1909); Compt. Rend. 149, p. 48 (1909).

[3] Jour. fur Landwirthschaft 58, pp. 101–112 (1910).

plant from the fleshy roots. The plants were selected by the size of their tops, and the effort was made to get average plants for each type of fertilization. The plants were carefully excavated, and as nearly as possible all the fleshy roots were collected. In some instances growth had been so extensive that adjacent roots were much interlaced, and it was impossible to secure one plant without destroying all others around it. Therefore, our largest, heaviest roots were more or less incomplete.

On the day following the collection of the specimens the roots were shipped from Concord to the experiment station, where they were placed in a cool cellar. The process of washing free from soil, weighing when free from surface moisture, drying and grinding, was very laborious and required several weeks, owing to the weight and bulk of the material. There is always danger of respiratory changes during the period of preparation, between collecting and drying; but it is believed that they were reduced to a minimum by keeping the roots in a cool place at about 10° C. Washing was performed within a few days after digging, and the weights of the fresh roots were obtained before there could have been any respiratory losses.

The material was prepared for drying by passing the crown and roots through a hand-lever fodder-cutter by which they were cut into pieces about 2 centimeters in length. Drying was done in a large oven at a temperature between 50° and 60° C., and the material was dried until sufficiently brittle to be easily ground. The weight of the specimen was taken at this stage, and then the entire lot was coarsely ground in a drug-mill, after which it was sampled by quartering and the sample reduced to a powder which would pass though a 1 millimeter mesh sieve. Moisture determinations were then made in the powdered samples, from which were calculated the weights of absolutely dry matter contained in the specimen roots.

Three different series of samples have been studied during this investigation.

The first series consisted of 44 roots, or 4 specimens from each of 11 plots, used for testing different quantities and different seasons of application of nitrate of soda. They were collected in November, 1908, two years after the field had been set with plants, by Mr. E. F. Gaskill of the agricultural

department of the experiment station, and were prepared for analysis in part by the fertilizer section and in part by the feed and dairy section of the department of chemistry.

The second series consisted of 76 roots, or 4 from each of 11 nitrogen plots before mentioned, together with 4 plots used for a test of different quantities of superphosphate and 4 plots for different quantities of muriate of potash. These samples were secured by Mr. Gaskill and the writer in November, 1910, and were prepared for analysis under the supervision of the latter.

The third series consisted of 16 roots, or 4 from each of 4 of the nitrogen plots, and were gathered under the supervision of Mr. C. W. Prescott on June 23, 1911, and were prepared for analysis by the writer.

All the analytical work has been based on the methods of the Association of Official Agricultural Chemists,[1] except where departures are mentioned as necessary owing to the character of the material.

Amount of Fertilizers applied.

Each plot in these tests contained one-twentieth acre and was 129 feet long by 16 feet 10½ inches wide. At the time of setting the plants the entire area received a uniform dressing of the following chemical fertilizers: —

	Pounds per Acre.
Lime,	2,000
Fine-ground bone,	1,000
Nitrate of soda,	150
Acid phosphate,	600
Muriate of potash,	350

No check plots without fertilizer were included in the plan.

The annual top-dressing was applied to the different plots in the following quantities per acre: —

[1] Bulletin No. 107 Revised, Bur. of Chem., U. S. Dept. of Agr.

	Plot Number.	Nitrate Soda (Pounds).	Acid Phosphate (Pounds).	Muriate Potash (Pounds).
No nitrate,	1, 40	-	200.1	260.0
Low nitrate,	31, 32, 33	311.2	200.1	260.0
Medium nitrate,	34, 35, 36	466.6	200.1	260.0
High nitrate,	37, 38, 39	622.4	200.1	260.0
No phosphate,	5	466.6	-	260.0
Low phosphate,	6	466.6	133.4	260.0
Medium phosphate,	7	466.6	200.1	260.0
High phosphate,	8	466.6	266.8	260.0
No potash,	9	466.6	200.1	-
Low potash,	10	466.6	200.1	173.4
Medium potash,	11	466.6	200.1	260.0
High potash,	12	466.6	200.1	346.8

The nitrate of soda was applied to plots 31, 34 and 37 in the spring before growth began; to plots 32, 35 and 38 in the summer after cutting had ceased; and to plots 33, 36 and 39, one-half in spring and one-half in summer. All phosphate and potash salts were applied in the spring.

Effect of Fertilizers on the Weight of Roots.

Since the marketable crop from the asparagus plant must be grown almost entirely at the expense of the reserve plant food stored in the crown and roots, the size of the roots at the beginning of the growing season would seem to be an important factor in the yield of sprouts. While their relationship has not yet been determined, it has been noted that the different top-dressings influenced the size of the roots to a marked extent.

The effects of nitrate of soda have been observed in all three series of samples, but only one series has afforded an opportunity to study the effects of phosphates and of potash salts. Nevertheless, the series gathered in 1910 was at the end of the fourth season of growth, and hence should have the cumulative effect of three annual dressings.

Effect of Different Amounts of Nitrate of Soda.

Season of 1908, Average Roots.

	Plot Number.	Fresh Weight (Grams).
No nitrogen,	1, 40	1,027
Low nitrogen,	31, 32, 33	947
Medium nitrogen,	34, 35, 36	1,248
High nitrogen,	37, 38, 39	1,127
Season of 1910, Average Roots.		
No nitrogen,	1, 40	2,128
Low nitrogen,	31, 32, 33	2,362
Medium nitrogen,	34, 35, 36	2,703
High nitrogen,	37, 38, 39	2,464
Season of 1911, Average Roots.		
Low nitrogen,	31, 32	2,259
Medium nitrogen,	34, 35	2,555

It is noted that the medium application of nitrate of soda has produced the heaviest average roots in each season.

Effect of Phosphate and Potash Salts.

Season of 1910, Average Roots.

	Plot Number.	Fresh Weight (Grams).
No phosphate,	5	1,783
Low phosphate,	6	2,853
Medium phosphate,	7	2,735
High phosphate,	8	2,246
No potash,	9	1,674
Low potash,	10	2,395
Medium potash,	11	2,893
High potash,	12	2,709

In spite of the large application of bone, acid phosphate and muriate of potash at the time of setting the plants, the absence

of either in the top-dressing produces a notably lower average weight of roots. The medium applications of phosphate and of potash salts produce the highest average weights of roots.

Rousseaux and Brioux[1] found the heaviest roots where manure and chemicals were combined, and it is of interest that the fresh weight was 2,600 grams, which is practically the same as the weight of our roots from the plots receiving top-dressings of medium amounts of fertilizers.

Effect of Season of Application of Nitrate of Soda on Weight of Roots.

Spring Application (Grams).

	Plot Number.	1908.	1910.	1911.
Low,	31	1,025	2,545	1,852
Medium,	34	1,260	2,733	2,776
High,	37	1,336	2,854	-
Average,	-	1,207	2,711	2,314

Summer Application (Grams).

	Plot Number.	1908.	1910.	1911.
Low,	32	923	2,004	2,666
Medium,	35	1,274	2,289	2,335
High,	38	1,302	2,311	-
Average,	-	1,166	2,201	2,501

Spring and Summer Applications (Grams).

	Plot Number.	1908.	1910.	1911.
Low,	33	895	2,538	-
Medium,	36	1,211	3,089	-
High,	39	730	2,227	-
Average,	-	945	2,618	-

The summer top-dressing with nitrate has produced smaller mature roots than the spring top-dressing, in both years 1908 and 1910. On the other hand, the roots of 1911, taken at the end of the cutting season in the summer, show variable results, with the average weight heavier on the summer-dressed plots.

[1] *Loc. cit.*, p. 312.

The individual roots in this summer collection showed much wider variations than the late fall series, which is attributed to the difficulty of judging average plants by the young shoots, and it is probable that the different plots are not as fairly represented as in the fall collections.

Effect of Fertilizers on the Fertilizing Constituents of the Roots.

The fertilizing constituents of asparagus roots were found by Rousseaux and Brioux[1] to be as follows: —

	Manure only (Per Cent.).	Manure and Chemicals (Per Cent.).
Dry matter,	28.26	26.27
Ash,	6.90	7.22
Nitrogen,	1.20	1.73
Phosphoric acid,	.50	.48
Potash,	1.23	1.57
Lime,	.31	.41
Magnesia,	.04	.05
Sulfuric acid,	.33	.36

Wichers and Tollens[2] reported the following results on the principal fertilizing constituents: —

	Roots (Per Cent.).	Crown (Per Cent.).
Moisture,	3.00	3.86
Nitrogen,	2.26	1.64
Phosphoric acid (P_2O_5),	.89	.54
Potash (K_2O),	1.44	1.60

The general average of fertilizing constituents calculated from the various analyses made at this experiment station is as follows: —

[1] *Loc. cit.*, p. 312.
[2] *Loc. cit.*, p. 109.

	Per Cent.
Dry matter,	21.68
Ash,[1]	6.56
Nitrogen,	1.95
Phosphoric acid (P_2O_5),	.48
Potash (K_2O),	2.36
Lime (CaO),	.34
Soda (Na_2O),	.30
Magnesia (MgO),	.17
Sulfuric acid (SO_3),	.56

An interesting fact shown by this table is the higher average percentage of sulfuric acid over that of phosphoric acid. The proportions of fertilizing constituents were varied somewhat by the applications of different quantities of the chemical fertilizers, as is usually observable in similar experiments with crops.

Effect of Nitrate of Soda on Ash Constituents.

Roots of 1908.

	No Nitrate, Plots 1 and 40.	Low Nitrate, Plots 31, 32, 33.	Medium Nitrate, Plots 34, 35, 36.	High Nitrate, Plots 37, 38, 39.
Ash,	5.73	6.40	6.69	6.59
Phosphoric acid,	.47	.53	.47	.51
Potash,	2.27	2.33	2.46	2.54
Lime,	.30	.28	.32	.34
Soda,	.07	.20	.27	.26
Magnesia,	.13	.14	.15	.15
Sulfuric acid,	.39	.48	.52	.52

Effect of Superphosphate on Ash Constituents.

Roots of 1910.

	No Phosphate, Plot 5.	Low Phosphate, Plot 6.	Medium Phosphate, Plot 7.	High Phosphate, Plot 8.
Ash,	6.81	7.09	7.54	7.34
Phosphoric acid,	.47	.46	.46	.49
Potash,	2.36	2.66	2.73	2.54
Lime,	.41	.32	.37	.38
Soda,	.43	.35	.38	.33
Magnesia,	.18	.16	.21	.19
Sulfuric acid,	.69	.62	.68	.63

[1] Ash determinations and all ash analyses were made in the fertilizer section by Mr. H. D. Haskins and Mr. L. S. Walker.

Effect of Muriate of Potash on Ash Constituents.

Roots of 1910.

	No Potash, Plot 9.	Low Potash, Plot 10.	Medium Potash, Plot 11.	High Potash, Plot 12.
Ash,	5.94	6.17	6.18	7.10
Phosphoric acid,	.44	.42	.46	.48
Potash,	1.44	2.10	2.20	2.53
Lime,	.38	.33	.34	.40
Soda,	.55	.48	.33	.33
Magnesia,	.19	.18	.19	.20
Sulfuric acid,	.66	.57	.62	.62

The presence or absence of phosphoric acid in the top-dressing produces little or no perceptible effect on the ash and ash constituents, even the phosphoric acid percentages being remarkably uniform throughout the whole series of tests. The absence of nitrate of soda and muriate of potash reduces the percentages of ash, and in the former case the soda and sulfuric acid are reduced also, while in the latter case it is the potash which is reduced. Lime and magnesia are apparently unaffected by the variations in top-dressings.

Effect of Fertilizers on the Nitrogen and Nitrogenous Reserve Material.

The nitrogenous matter stored in the roots was definitely affected by the different quantities of nitrate of soda applied, and also by its season of application; but the superphosphate and muriate of potash had no effect on the percentage of this element.

Effect of Nitrate of Soda on Nitrogen.

	Plot Number.	1908 (Per Cent.).	1910 (Per Cent.).
No nitrate,	1, 40	1.28	1.53
Low nitrate,	31, 32, 33	1.69	1.82
Medium nitrate,	34, 35, 36	2.10	1.97
High nitrate,	37, 38, 39	2.10	2.05

Effect of Superphosphates on Nitrogen.

	Plot Number.	1910 (Per Cent.).
No phosphate,	5	2.27
Low phosphate,	6	2.05
Medium phosphate,	7	2.18
High phosphate,	8	2.04

Effect of Muriate of Potash on Nitrogen.

	Plot Number.	1910 (Per Cent.).
No potash,	9	2.10
Low potash,	10	2.02
Medium potash,	11	2.06
High potash,	12	2.08

Effect of Season of Application of Nitrate of Soda on the Nitrogen.

Spring Application.

	Plot Number.	1908 (Per Cent.).	1910 (Per Cent.).
Low,	31	1.57	1.64
Medium,	34	2.18	1.97
High,	37	1.96	1.96
Average,	–	1.90	1.86

Summer Application.

Low,	32	1.78	1.99
Medium,	35	2.23	2.01
High,	38	2.36	2.22
Average,	–	2.12	2.07

Spring and Summer Applications.

Low,	33	1.73	1.82
Medium,	36	1.92	1.94
High,	39	1.98	1.98
Average,	–	1.88	1.91

The higher percentage of nitrogen due to the summer top-dressing with nitrate of soda is very noticeable, as was the smaller average weight of roots, compared with the spring application.

The roots of 1911 gathered in the summer just before the annual summer top-dressing showed the same general differences between the spring top-dressing and summer top-dressing.

Spring Application.

Plot Number.	Per Cent.
31,	1.81
34,	2.05
Average,	1.93

Summer Application.

Plot Number.	Per Cent.
32,	2.06
35,	2.15
Average,	2.10

Whatever exhaustion of material occurred during the cutting season did not influence the percentages of nitrogen in the roots.

Effect of Fertilizers on the Non-nitrogenous Material of Asparagus Roots.

Wichers and Tollens [1] have shown the proximate composition of asparagus roots and crowns to be as follows: —

	April.		July.	
	Roots.	Crowns.	Roots.	Crowns.
Moisture,	3.00	3.86	3.61	2.93
Ash,	12 20	15.21	11.77	11.67
Crude protein,	14.13	10.25	16.56	9.90
Crude fiber,	8.72	15.42	13.54	19.79
Fat,	.72	1.59	1.10	1.67
Nitrogen-free extract,	61.23	53.67	53.42	54.04
	100.00	100.00	100.00	100.00
Sugar,	36.80	17.70	23.19	15.32
Pentosans,	6.25	9.77	7.73	11.48

[1] *Loc. cit.*, p. 109.

The writer has found the composition of the combined crowns and roots in his samples to average as follows: —

	November, 1908, 16 Roots.	November, 1910, 4 Roots.	June, 1911, 8 Roots.
Dry matter,	-	22.40	18.34
Ash,	6.24	7.68	8.87
Crude protein,	11.03	11.02	12.75
Crude fiber,	15.39	17.89	23.66
Fat,	1.00	1.58	1.63
Nitrogen-free extract,	66.34	61.83	53.09
	100.00	100.00	100.00
Sugar,	41.43	35.85	20.87
Pentosans,	8.78	10.12	11.66

The sugar which forms such an important percentage of the reserve material has been found to be a soluble carbohydrate readily hydrolyzed to glucose and fructose, having a rotary power differing widely from cane sugar, but otherwise resembling it in all its chemical properties.[1]

In the series of 1910 and that of 1911 particular attention was paid to the sugar to determine if fertilizers had any effect on its development.

The sugar was extracted by heating 2 grams of the dry, finely powdered material with 50 cubic centimeters of water in the boiling water bath. Basic lead acetate and alumina cream were added after the solution was cool, and the volume made up to 100 cubic centimeters. When the precipitate had settled, which it usually did in an hour, the solution was filtered through a dry filter. The lead was then removed with sodium carbonate and an aliquot of 50 cubic centimeters was inverted by HCl by standing for twenty-four hours at 20° to 25° C.

About half of the samples showed the presence of reducing sugars before inversion, but seldom more than a trace; the remainder showed no presence of reducing sugars

The total invert-sugar was determined by use of Fehling's solution in the usual manner, and the copper was determined volumetrically.

[1] Tanret, *loc. cit.*; Wiebers and Tollens, *loc. cit.*; Morse, Jour. Am. Chem. Soc., 33, 211–215.

In the nitrogen series the sugar was determined in each root and then averaged for the plot as in the nitrogen investigation, but in the superphosphate and potash series only two roots from each plot were used.

Effect of Nitrate of Soda on Sugar.

	Plot Number.	1910 (Per Cent.).	1911 (Per Cent.).
No Nitrate.			
	1	29.80	-
	40	37.41	-
Low Nitrate.			
Spring application,	31	35.76	25.76
Summer application,	32	29.79	13.30
Spring and summer application,	33	31.85	-
Medium Nitrate.			
Spring application,	34	34.56	27.84
Summer application,	35	38.56	25.90
Spring and summer application,	36	31.59	-
High Nitrate.			
Spring application,	37	35.48	-
Summer application,	38	36.04	-
Spring and summer application,	39	34.43	-

Effect of Superphosphate and Muriate of Potash on Sugar.

	Plot Number.	1910 (Per Cent.).
No phosphate,	5	26.02
Low phosphate,	6	25.89
Medium phosphate,	7	28.05
High phosphate,	8	24.86
No potash,	9	28.72
Low potash,	10	32.56
Medium potash,	11	32.10
High potash,	12	34.79

The percentages of sugar vary independently of the various kinds of top-dressing, since there are wide variations in the results for Plots 7, 11 and 34, on which identical amounts of fertilizers had been applied.

The season of application of nitrate of soda apparently did not influence the percentages of sugar in the fall roots, but there is less apparent exhaustion in the 1911 roots where nitrate had been applied in the spring (Plots 31 and 34).

Since the variations in sugar showed so little relationship to the scheme of fertilization, it was not deemed worth while to pursue the investigation into the effects upon fiber and pentosans, as there are too many factors to be correlated.

Summarizing the results briefly, it has been shown that the medium amounts of chemicals in this series of fertilizer tests produced the most favorable results on size and composition of the asparagus roots.

The absence of any one of the three fertilizers resulted in depression of weight of root, which was accompanied by a depression in nitrogen in the absence of nitrate of soda, and by a depression in the potash and ash in the absence of muriate of potash.

The summer top-dressing with nitrate of soda produced smaller roots than the spring top-dressing, but with notably higher percentages of nitrogen. The exhaustion of the roots by the cropping season was most manifest in the percentages of sugar in the roots from the summer top-dressed plots.

The thanks of the author are due Messrs. Haskins and Walker for the analytical data on ash and ash constituents, to Dr. W. P. Brooks, director, for the fertilizer data, and to Dr. J. B. Lindsey, chemist, for many timely suggestions.

DEPARTMENT OF ENTOMOLOGY.

REPORT OF THE ENTOMOLOGIST.

H. T. FERNALD.

During the year 1912 the work in the department of entomology has been mainly devoted to the prosecution of projects already begun, with few additions to the list.

The insect collection has been somewhat added to and maintained in its previous good condition. Its constant use for reference by every one working on insects at the college, and by many from outside, has been very noticeable, and its value for this purpose is constantly increasing as it becomes more complete.

The number of letters of inquiry received during the year has been so large as to require, on an average, several hours' attention each day, and, as was the case last year, has covered many topics. Most of these inquiries have not been about the more noticeable insects, but about what may be termed those of secondary prominence, for though destructive they are not as liable to attract attention. As less is naturally known about these insects than about the more evident ones, more time has necessarily been required to give the information desired than was the case a few years ago, and in some instances personal visits have been required in order to fully understand conditions before the best advice as to treatment could be given.

Under the Hatch act further observations on the dates of hatching of the young of the oyster-shell, pine-leaf and scurfy scales have been made, and experiments on the control of the onion maggot have been begun. These last are reported on more fully elsewhere. Tests of various insecticides have been made and are also reported elsewhere. Methods for the protection of

seed corn from wireworms have been continued, and an improvement on those previously discovered is now under consideration for next season.

Under the Adams fund the two projects mentioned in former reports have been carried farther. The causes of the burning of foliage by arsenical poisons have been given much study, accompanied by over a thousand separate field tests, each followed by an examination of the results of the treatment at intervals of a day or two for more than a month. Closely involved in this has been the consideration of the nature of the insecticides used, and in this portion of the work the co-operation of the chemical department of the station has been invaluable.

If the causes of injury to foliage following the application of arsenicals are to be clearly understood, it is evident that the composition of the materials applied must be known. The injury may in fact be due, either to impurities in the materials themselves, to their decomposition after application to the leaves, or to something normally and necessarily present in them. To avoid the first possibility, materials as nearly absolutely pure as it is possible to obtain have been sought, and have only been found after many trials, it being evident that almost none of the insecticides on the market at the present time are pure or even anywhere near it. As it is quite possible that the impurities are the cause of the injuries, it is of course desirable to eliminate these, and in the materials used the first season it was supposed that this had been accomplished. Too late it was learned that this was not the case, and that the treatment was made with substances which had been guaranteed pure by the manufacturers, but which were far from being so. The consequence was that the chemical department was obliged to take up the problem of finding methods by which pure Paris green, arsenate of lead and arsenate of lime could be made, and of providing this department with them in quantities sufficient for use. This has been successfully accomplished, and the spraying last year, in part, and the past summer has been with these.

The actual value of wasps as parasites has never been investigated carefully. General statements that they are "extremely useful," or that "their importance can hardly be overestimated,"

are in reality little more than guesses, and it has seemed desirable to investigate the subject more scientifically in order to determine their real efficiency. To do this with all wasps is of course impossible, so a group of these insects widely distributed in all parts of the country has been selected for study. To clear the way and establish a firm foundation for the work it has been necessary to ascertain how many kinds are involved, and their relative abundance in different localities, to be followed by a determination of their fertility, the nature and amount of the food they consume, their mortality and numerous other factors which enter into the problem. Most of the preliminary work on this project has now been completed, and considerable has been accumulated on its other aspects. It is too soon to generalize on this subject, but it has already become evident that these insects are decidedly beneficial because of their choice of food material which is in most cases chosen from among our worst pests.

The results of experimentation on color vision in bees — an Adams fund project in charge of the apiarist of the station — are stated as follows: —

While much limited in time available for the several branches of bee-keeping work this year, progress in experimentation on the color vision of bees has been made. One supposition has been proven with relative satisfaction. An instrument for counting has been devised and relatively perfected. A foreign work which applies to the problem has been translated. Correlated experiments have given and are giving good results.

So far as opportunity has offered, studies on the distribution of our worst pests in the State have been continued and the results tabulated for future reference.

Other work of the department is more fully detailed elsewhere in this report under the titles, "Tests of Insecticides," "Experiments for the Control of the Onion Maggot" and "Insect Record for 1912 in Massachusetts."

EXPERIMENTS FOR THE CONTROL OF THE ONION MAGGOT.

H. T. FERNALD AND A. I. BOURNE.

Onions are grown on a large scale in many parts of Massachusetts, particularly in the Connecticut valley. Fields covering 10, 15 or even 25 acres are common, and the crop is an important one.

For some years the onion maggot, *Phorbia cepetorum* Meade, has been a serious enemy of the onion grower in this region, much loss having been caused by its ravages. In 1911 this was particularly the case, one individual who had 6 acres planted estimating his loss by the attacks of this insect at about $400. Quite a part of this was on one plot covering only 2 acres, which was so thoroughly infested as to make the crop there hardly worth gathering. It has seemed desirable on this account to investigate methods for the control of the onion maggot, particularly as applied to large fields.

The Problem.

1. To determine the effectiveness of various methods for the control of the onion maggot.
2. To determine whether any which prove effective can be used in large fields without too great cost.

Previous Experiments.

An examination of the literature on this subject showed that most of the work had been primarily with other maggots such as the cabbage maggot, *Pegomyia brassicae* Bouché, and that conclusions had apparently to a large extent been drawn from these experiments. Where this was not the case it seemed probable

from what was stated that the tests had been made upon but a few rows of onions at most.

To regard methods of controlling the cabbage maggot as equally applicable to the onion maggot is a rather doubtful position to take. Cabbages are grown from seed under glass or screens, and when they have arrived at the proper size are transplanted; and are usually placed about 2 feet apart. Onions (except for "sets") are planted where they are to remain until gathered, only an inch or two apart, and with the rows from 12 to 15 inches distant. Conditions, therefore, are widely different, especially when a large acreage is concerned.

With these facts in mind some of the treatments described could immediately be discarded as impracticable under the conditions existing, whether reported as of value or not. Others, it seemed, might possibly be made use of, — though the question of their cost for large fields would need to be determined, — while others, still, appeared on their face to be rather promising. A new substance, nicine, which had been received for trial was also included in the list of materials to test.

Conditions of the Experiment.

For experimental purposes on a rather small scale, preliminary to later, more extended ones, two plots of land were reserved close by where onions had been growing the preceding year, and where the maggots had been very abundant. Each was about 70 by 75 feet in dimensions. The north plot lay somewhat higher than the other, and the soil was somewhat sandy and lighter than that of the south plot, where it was rather heavy. Both plots sloped slightly toward the south, and the two were separated only by a grass roadway. In the north plot the onions were planted in rows about a foot and a half apart, while in the other they were only a little over a foot apart. In both plots the rows ran north and south.

The "catch" of the seed in neither plot was satisfactory. Gaps often a foot or two in length were frequent in the rows, particularly in the north plot, and this may have had some influence upon the results, as it is claimed that the maggots after destroying a plant may at least in some cases pass to the next

one in the row. If this be correct, gaps in the row would tend to reduce the number of plants injured below what would be the case in full rows.

Treatment was begun soon after the plants appeared, when they were not more than an inch and a half high, and was continued at proper intervals until the maggots were seen to be leaving the plants to pupate. At the time of the first treatment no trace of maggots or of flies laying eggs could be found. Each material was applied to specified rows in each plot. Between these, untreated rows — usually several — were reserved as checks.

The weather during the period the tests were made was, on the whole, quite favorable, there being little rain, and what there was, mainly in the form of light showers. In no case did rain follow an application so closely as to thereby much impair its effectiveness. Occasionally the wind was strong enough to cause a little difficulty in applying dusting materials, but in general the days were clear, warm to hot, and with little wind.

Examination of the results of each kind of treatment was made frequently, and all plants found infested were removed, care being taken to remove all the maggots at the same time, that they might not go to other plants and thereby increase the apparent infestation.

No exact record of the number of maggots found in any single plant was kept, but it was noticed that during the earlier part of the season there were usually but one or two maggots in each infested plant. Later, as the plants became larger, it was not uncommon to find 10 or 12, or even more, in a plant. Wireworms and white grubs were present, attacking the onions, but in very small numbers.

Experimental Work.

Examination of the records of work on this insect carried on elsewhere finally resulted in the selection of the following materials for trial: (1) carbon disulfid; (2) nicine; (3) powdered hellebore; (4) hellebore decoction; (5) soap wash; (6) carbolic acid and lime; (7) kerosene emulsion of three different strengths; (8) carbolic acid emulsion also of three different

strengths. More detailed accounts of the use of each of these, and the results, follow: —

Carbon Disulfid. — This substance has been recommended as very effective. It is applied in shallow grooves near the plants, so that the gas into which it becomes converted may penetrate through the soil to the onions and destroy the maggots. The fluid itself, however, is liable to kill the plants if it reaches them.

In this experiment a shallow groove was made about 2 inches from each plant, and a little of the liquid was poured into this. The groove was then quickly covered. The application is rather slow and tedious, particularly if more than a small area is thus treated, as the grooves must be short, unless considerable material is wasted, in order to cover quickly.

This treatment proved to be very unsatisfactory. For some reason many of the plants were killed, indicating that either too much disulfid was applied; that the grooves were too near the plants; or that the gas as well as the liquid is dangerous to use. In this experiment about 90 per cent. of the plants died. On the other hand, a large proportion of the plants which escaped destruction by the treatment became infested with maggots, from which it may be concluded that where the application is so far from the plant or so little is used as to avoid injury no protection from maggots is obtained. It is possible that with an exact amount of material to apply to each plant carefully worked out, and the distance to apply this also known, protection without injury might be secured; but it is evident that such care in application as this would require would be impossible in the case of large fields, where the amount of time demanded to do it properly would make the cost prohibitive.

Even when not applied with the utmost care the cost is great. Carbon disulfid in small quantities costs about 30 cents per pound. It might, perhaps, be obtained in bulk for half this price, but taking the higher cost and calculating the amount necessary to treat 1 acre we would have an expenditure of from $12 to $14, while the time required to apply it to this area, based on wages at $1.75 per day, would be rather more than this, and if more care in the application were given the time would probably be more than doubled. The cost of using carbon

disulfid per acre, therefore, allowing the material to be purchased at half what it actually cost for the experiments, would be at least from $20 to $30 per acre, — a prohibitive expense.

Nicine. — This substance, manufactured by the Hood Chemical Company of Chicago as a deodorant, disinfectant and germicide, was offered for trial as an insect repellant. It is a powder, and directions furnished by the company were as follows: —

> Where a plant or tree is infected with root maggots shake off as much of the earth from the roots as possible. Then sprinkle nicine over the roots and plant in fresh soil, and if convenient make a small circular ditch about 3 or 4 inches deep around the plant and 1½ to 2 feet from the center. Sprinkle nicine freely in this ditch, cover up with soil, and the plants will not be bothered with maggots or insects.

It was manifestly impossible to follow these directions in the case at hand. The nicine was therefore dusted along the rows, care being taken to place a good supply around the base of each plant. As the maggot must work down along the plant to the bulb, where it feeds, this method would seem to force the maggots to pass through, or at least close to, the powder, which has a very pronounced odor.

The result of this experiment was unsatisfactory, as plants in the rows treated became infested shortly after the application. In fact, some of the earliest infestations in the field were in rows treated in this way.

At such prices as have been quoted for this material, enough to treat an acre in this way would cost about $50, and the labor in applying it would cost about $12 or $13. Evidently, then, this material is not available for use on large onion fields, irrespective of its effectiveness, because of the expense which would be incurred.

Powdered Hellebore. — Ordinary powdered hellebore was dusted liberally along the rows around and over the bases of the plants, with the idea that the young maggots working down to the bulbs to feed would come in contact with it and be destroyed. It has been supposed that it might also act to some extent as a repellant, preventing egg laying.

Results from this treatment could at best be rated as only

fair. The application was repeated three times, and this of course meant a large increase in cost. Hellebore in sufficient amount to treat an acre once would cost, at the rate paid for the material used in these tests, more than $50, and the labor in applying it about $13 more. Even if it were effective as a treatment its cost would, accordingly, prevent its use in large onion fields.

Hellebore Decoction. — This was prepared in accordance with directions given by Smith (New Jersey Bulletin No. 200), by steeping 2 ounces of powdered hellebore in a quart of water for half an hour, stirring occasionally. It was then diluted, to make 1 gallon of liquid, and applied thoroughly to the ground at the base of each plant. If a large amount of this decoction be made at one time it can be kept without losing strength if placed in tight containers.

This material was applied through a nozzle giving a coarse stream, only enough pressure being given to the pump to cause a steady flow, without breaking up the decoction into a spray. A liberal amount was placed at the base of each plant in this way. Three applications were made at about ten-day intervals.

Results obtained were very unsatisfactory, as the treatment did not seem to have any effect whatever on the infestation. Its cost, too, though less than that of the powdered hellebore, placed it as too expensive for use. Decoction sufficient for one application to an acre would cost about $15, while the expense of application would be about $12. Three treatments, therefore, would be prohibitive from this standpoint, though necessary, even according to those who report some success with this material.

Soap Wash. — This was made by dissolving 1 pound — about 2 bars, in most cases — of good soap in 10 gallons of water. It was poured along the rows, using a force pump without a nozzle so that a solid stream could be obtained, and the ground around the plants was well soaked with it. Three treatments were given at intervals of about ten days except in one case where rain seemed to make it desirable to repeat the application without waiting for the end of this period.

Results with this material were at best only moderately good, infection appearing to some extent along the rows treated in

this way. As the cost of soap enough to cover an acre once in this way would be from $8 to $10, and the labor involved would come to about $14, three treatments, each costing from $20 to $24, would manifestly be too expensive.

Carbolic Acid and Lime (*"Carbolized Lime"*). — The object of this treatment is to cover the ground around each plant with a coating through which the maggots cannot penetrate, much as tarred paper discs act in the case of the cabbage maggot. The practical difficulty with it is that in cultivation and weeding the coating becomes broken and therefore not effective.

To prepare it, lime is slaked to a thick cream. Three pints of this are added to a gallon of water, and a tablespoonful of crude carbolic acid is stirred in. The mixture is then poured along the rows to form a complete coating around each plant.

The odor of the carbolic acid was very noticeable for some time near the plants treated in this way. It was necessary to repeat the treatment, however, after each cultivation or row weeding, as in every case the coating was more or less broken by this work.

The results were far from satisfactory. Either the coating was not sufficiently thick to prevent the maggots from passing through it, or they went beneath it. In any case, the infestation in the rows treated with this material was as great as in the check rows.

The cost of the material was not great, nor was the time necessary to prepare it. Application, however, had to be carefully made, and the total cost per acre for a single treatment would be about $23 or $24. At least three applications would be necessary following cultivation, which would make this treatment too expensive.

Kerosene Emulsion. — This material was prepared according to the usual formula, and was diluted to three different degrees: 1 part of stock emulsion to 9, 1 to 14 and 1 to 19 parts of water. It was applied in the same way as the soap wash and repeated at intervals of from ten to fourteen days. No injury to the plants at either strength was observed, nor did the different degrees of dilution appear to affect the results as regards the maggots.

Little protection from maggots was found as the result of

this treatment. The material for 1 acre would cost about $10, and the cost of labor, making and applying it would be about $12 or $14 more. The total cost for three applications to an acre of onions would therefore be $60 or more, and would make this treatment too expensive, even if it were effective.

Carbolic Acid Emulsion. — This was prepared as follows: soap 1 pound, water 1 gallon, crude carbolic acid 1 pint; dissolve the soap in water (boiling, to hasten solution); add the carbolic acid and churn as for kerosene emulsion until a creamy substance thoroughly emulsified has been produced.

This was diluted to three strengths: 1 part to 30, 1 to 40 and 1 to 50 parts of water. It was applied in the same way as the soap wash and the application repeated every other week.

The results obtained so far as control of maggots is concerned were the most satisfactory of any, decidedly checking the infestation in the rows to which it was applied. On small areas it would appear to be the most effective of the materials tested, and its application to large fields would be determined largely by its cost. This, for materials and labor together, was calculated at from $8 to $12 per acre, according to the strength used. It would probably need to be applied at least three, and probably four times, however, to be effective, which would make the total cost from $35 to $50. It should also be borne in mind that it was not an entire success, but only relatively so. So far as could be determined the three strengths were about equally effective.

General Conclusions.

None of the materials tested proved satisfactory, though the carbolic acid emulsion gave the best results. It was also one of the less expensive treatments, costing from about $8 to $12 per acre for each application. It is not improbable that some of the other materials, applied frequently and with care, might prove of some value, but only on small areas would this be possible at a reasonable expense.

The whole experiment indicates: (*a*) that no entirely effective method of controlling the onion maggot has as yet been discovered; (*b*) that many of those thus far recommended are of little value, at least on large fields; (*c*) that the cost of treat-

ment with most of them is so great as to render them unavailable for large areas. Finally, the most promising line of investigation seems to be the discovery of something which will effectually repel the insects or destroy the maggots, and which can be applied either as a part of the planting process or in connection with cultivation, thus avoiding the necessity of special treatments by combining these with usual methods of cultivation. Experiments along these lines are now being planned.

DEPARTMENT OF HORTICULTURE.

REPORT OF THE HORTICULTURIST.

F. A. WAUGH.

The experimental work in horticulture has been carried forward during the past year without change of policy or personnel, unless we note the fact that Dr. J. K. Shaw is directing a larger part of his time to the study of pomological problems, and a diminishing part to investigations in plant breeding. Special mention may be made of the beginning of an extended investigation in the interrelations of scion and stock in graftage. It is contemplated that these experiments will cover a period of twenty years or more. They will be conducted in part on land in Amherst leased by the experiment station for this purpose; but certain practical phases of the work will be checked by duplicate tests made in different parts of the State in co-operation with fruit growers. These problems are of great theoretical interest and greater practical importance, and the present studies are begun in the hope of many valuable results to follow.

Attention should be drawn at this time to the increasing demand for practical experiments in floriculture and market gardening. These important industries have been measurably neglected in the experimental work of the past, and the men now engaged in these lines of work have repeatedly signified their wish for help and their willingness to co-operate with the experiment station in planning and carrying out desirable lines of experiment. Projects for experimental work have already been submitted by the heads of the departments of floriculture and market gardening, and the careful consideration of those projects is herewith urged.

Another line of work which should be taken up at the earliest possible date is that of horticultural manufactures, or the home industries of canning, preserving, drying, evaporating, jam and jelly making, etc. These could be made a source of substantial profit to fruit and vegetable growers. While this work should be promoted in all its aspects by the college, it seems that the most important part of it, and the part which should be first taken up, is the work of investigation and practical experiment. A project for the work in horticultural manufactures has been filed, and I also urge careful attention to this matter.

The experimental work in this division, and especially the work now in charge of Dr. J. K. Shaw, demands some additional clerical assistance, both in the field plots and in the office. The present needs could be most efficiently met by the appointment of a graduate assistant who would give one-half his time to this work, the remainder being spent in postgraduate study; and I recommend that such an appointment be made at the earliest possible moment.

THE INHERITANCE OF BLOSSOM COLOR IN BEANS.

J. K. SHAW.

For several years we have given considerable time to the study of heredity in beans. Nineteen varieties have been used, and the method uniformly followed has been to make a cross of two differing types and self-fertilize the progeny through four generations, keeping careful records of the characters under observation as they appeared.

The self-fertilization has been done by covering the plants with muslin bags, each supported by a short stick or bent wire. Some have been grown in the greenhouse during the winter, and these have of course required no protection. Some of the crossing has been done in the greenhouse and some in the field, in which case paper bags have been used for protection from insect interference. The parent plants have each received a number, and our records show just what plants were involved in any particular cross. The system of records used has already been described by the writer.[1] In this way a vast amount of data has been accumulated and many interesting questions are presented for study. It is the purpose of this paper to deal with the inheritance of blossom color, leaving the other characters studied for later consideration.

In the early part of the work the plants used were from commercial seed bought in the open market. When the writer took charge of the work the policy was adopted of securing pure races as quickly as possible by self-fertilizing individual plants, and since then these have been used in the crossing work. It is probable that some of the plants used first, while externally typical of the variety, were not gametically pure and led to confusing results.

[1] American Naturalist, Vol. XLV., p. 701 (1911).

1 2 3 4

FLOWER COLORS OF BEANS.

Fig. 1. Pink. Fig. 2. Light pink. Fig. 3. "Waxy pink." Fig. 4. Crimson. The upper figure in each case represents the inside and the middle figure the outside of the banner petal.

As indicated by external appearance the blossom colors of the varieties under experiment fall under four types. These have been designated as white, light pink, pink and crimson. In addition to these parental colors a new form has appeared, and this has been called "waxy pink" for want of a better term. All the colored types are somewhat variable, and some difficulty has been occasionally experienced, especially in the early stages of the work, in separating them; but it is believed that this has not been serious enough to affect the results. The blossom color of the varieties used is as follows: —

White: —
Creaseback.[1]
Davis Wax.
Golden-eyed Wax.
Keeney Rustless.
Red Valentine.
Wardwell.
White Marrow.
Light pink: —
Burpee Stringless.
Golden Carmine.
Giant Stringless.
Mohawk.
Warren.
Warwick.
Pink: —
Challenge Black Wax.
Currie.
German Black Wax.
Prolific Black Wax.
Crimson: —
Blue Pod Butter.

Inasmuch as the blossom color and the pigmentation of the seed-coat seem to be correlated, it may be well to state here the seed-coat colors of these varieties, as follows: —

Blue Pod Butter, buff.
Burpee Stringless, coffee brown.
Challenge Black Wax, black.
Creaseback, white.
Currie, black.
Davis Wax, white.
German Black Wax, black.
Giant Stringless, yellow.
Golden Carmine, mottled, buff and reddish.
Golden-eyed Wax, white; small yellow eye.
Keeney rustless, white; large dark-reddish mottled eye.
Mohawk, mottled, reddish brown.
Prolific Black Wax, black.

[1] In nomenclature we follow Jarvis, Cornell Exp. Sta. Bull. No. 260. Any one desiring a complete description of these varieties is referred to this bulletin or Bu. Plant Ind. Bull. No. 109.

Red Valentine, reddish mottled.
Wardwell, white; large dark-brownish eye.
Warren, deep red.
Warwick, deep reddish mottled.
White Marrow, white.

The blossoms of the varieties classified as white-flowered have been invariably a pure white so far as observed, with the exception of Red Valentine. This sort has occasionally shown flowers with a very slight pinkish tinge on the more exposed positions of the keel; while drying with age they take on a distinct waxy tinge. It should be noted that the seeds of this variety have mottled seed-coats while all the other white-flowered varieties are either white seeded or eyed.

The varieties classified as light pink have flowers with a distinct tinge of pink, especially on the keel. They do not show the waxy color of white-flowered sorts while drying, and are readily separated from them even though this pink tinge may be very slight. From the pink-flowered sorts, on the other hand, they are not so easily distinguished, and it is evident that a few errors have here been recorded, but care has been taken not to allow these to lead to any false conclusions.

The pink-flowered varieties have a deep shade of pink over the entire flower, including the inside of the banner petal, but the outside is white. The so-called crimson flowers of the Blue Pod Butter are more properly a purplish crimson, and invariably the leaves and stems of the plants are deeply tinged with dark purple. These flowers are distinguished from the pink ones, not only by their darker shade but more certainly by the outside of the banner petal which is purplish crimson instead of uncolored.

The waxy pink flowers have appeared only in crosses having Blue Pod Butter as one of their parents. They resemble the light pink blossoms but are readily distinguished from them. The pigment seems deepest on the outside of the banner, and the whole plant invariably has a peculiar waxy-brownish-yellow appearance.

These colors are well represented in the colored plate.

Turning now to a discussion of the tabulated data, Table 1 shows the results of crossing varieties with light pink flowers with white-flowered sorts, where only light pink and white-flowered plants resulted. Some such crosses gave pink-flowered plants, and these are given in Table 2. The results shown are generally in accordance with Mendelian expectation, assuming the light pink blossom to be dominant over white. There are two cases where a white-flowered parent has colored offspring. It is possible that in the cross Red Valentine and Giant Stringless this is due to error in observation of the color of the flowers of the parent plant on account of the effect of bagging to insure self-fertilization, this having a tendency in some cases to check color development. The same may be said regarding the similar case in Red Valentine × Mohawk. The case of the single light pink plant in Golden-eyed Wax × Giant Stringless is unexplained. Some departures from the numerical expectation are recorded. A marked excess of white-flowered plants occurs in the crosses involving Golden-eyed Wax, and a similar excess is shown in later tables when this variety is involved.

TABLE 1. — *Light Pink and White.*

	F_1.	F_2.			F_3 and F_4.					
					White Parents.			Light Pink Parents.		
		White.	Light Pink.	Total.	White.	Light Pink.	Total.	White.	Light Pink.	Total.
Burpee Stringless × Red Valentine,	Light pink,	8	40	48	-	-	-	0 32	8 67	8 99
Red Valentine × Burpee Stringless,	Light pink,	22	71	93	25	0	25	0 47	107 90	107 137
Burpee Stringless × Wardwell,	Light pink,	9	19	28	6	0	6	3	14	17
Burpee Stringless × White Marrow,	Light pink,	17	67	84	58	0	58	0 96	54 246	54 342
White Marrow × Burpee Stringless,	Light pink,	15	47	62	41	0	41	0 59	205 194	205 253
Giant Stringless × Golden-eyed Wax,	Light pink,	61	88	149	10	0	10	-	-	-
Golden-eyed Wax × Giant Stringless,	Light pink,	26	34	60	16	1	17	0 10	17 21	17 31
Giant Stringless × Red Valentine,	Light pink,	5	34	39	18	0	18	0 2	31 3	31 5
Red Valentine × Giant Stringless,	Light pink,	16	25	41	17 33	18 0	35 33	-	-	-
Giant Stringless × Wardwell,	Light pink,	24	53	77	84	0	84	0 25	14 88	14 113
Mohawk × Red Valentine,	Light pink,	9	22	31	-	-	-	-	-	-
Red Valentine × Mohawk,	Light pink,	17	27	44	89 6 0	0 6 23	89 12 23	0 20	15 51	15 71

In Table 2 are given results from certain crosses that are not in accordance with expectation, in that deeper colored flowers appear among the offspring than those possessed by either parent variety. In the cross of Golden-eyed Wax × Burpee Stringless there appear two pink and one crimson flower in the F_3 generation. These all occur among the progeny of a single selfed plant having light pink flowers. The pink-flowered plants bore black beans, while the crimson-flowered plant bore dark mottled beans. The significance of this correlation will be discussed a little later. In the crosses of Burpee Stringless and Giant Stringless with Keeney Rustless, pink flowers occur in both the F_2 and later generations, and in such numbers as to preclude the possibility of errors in observation. Coincident with these pink flowers occur black or dark mottled seeds, and coincident with the white flowers appear eyed beans, a character coming from the eyed parent, Keeney Rustless. The cross of White Marrow × Golden Carmine presents a variety of surprises hard to comprehend. As will be shown later, this is common with the White Marrow. It is most undependable in its behavior in crosses. It is evident that some of this is due to a mixture of strains which may be alike in external appearance but behave differently in crossing, but there are other abnormalities shown that will bear much investigation. The reciprocal crosses of Warwick and Creaseback show pink flowers, again coincident with black pigment in the seed coat. It is evident that Creaseback carries a factor that blackens any pigment it may encounter, at least so far as our experience goes, and this blackening is accompanied by pink flowers. None of the pink-flowered plants have bred true to flower color. All seem to be heterozygous.

TABLE 2. — *Light Pink and White.*

	F_1	F_2. White.	F_2. Light Pink.	F_2. Pink.	F_2. Total.	F_3 and F_4. White Parent. White.	F_3 and F_4. Light Pink Parents. White.	Light Pink Parents. Light Pink.	Light Pink Parents. Pink.	Light Pink Parents. Total.	Pink Parents. White.	Pink Parents. Light Pink.	Pink Parents. Pink.	Pink Parents. Total.
Golden-eyed Wax × Burpee Stringless, .	Light pink, .	9	25	0	32	31	0	21	0	21	–	–	–	–
							19	63	0	82				
							16	64	2	83[1]				
Keeney Rustless × Burpee Stringless, .	Light pink, .	3	8	6	17	4	2	0	22	24	6	8	13	27
							4	11	0	15				
Giant Stringless × Keeney Rustless, .	Light pink, .	5	5	10	20	–	3	4	11	18	6	0	27	33
							1	8	0	9	1	15	0	16
White Marrow × Golden Carmine, . .	–	6	2	7	15	42	0	15	0	15	1	0	5	6
							0	12	0	13[1]	0	18	45	64[1]
							0	1	0	6[2]	0	0	6	12[3]
							0	6	1	7	0	2	0	2
Warwick × Creaseback, ...	Pink, . .	9	13	66	88	–	–	–	–	–	–	–	–	–
Creaseback × Warwick, ...	Pink, . .	4	3	15	22	59	0	76	0	76	–	–	–	–
							40	120	0	160				

[1] Also 1 crimson, see text. [2] Also 5 "waxy pink." [3] Also 6 crimson.

In Tables 3 and 4 are given our results of crossing pink with white-flowered varieties, the division into two tables being simply for convenience in arrangement. A striking thing shown in this table is the excess of white-flowered plants in the crosses involving Golden-eyed Wax. This occurs in all cases except in the F_2 generation of the cross with Prolific Black Wax. It is seen also in crosses with light pink-flowered sorts, especially with Giant Stringless in Table 1, also in crosses with Blue Pod Butter in Table 5. The total number of hybrid plants from crosses of Golden-eyed Wax with pigmented flowered variations is 1,053, of which 407 are white-flowered, while the expectation of one-fourth of the total number is 262. This is a proportion of 1.59:1 instead of 3:1. This departure from expectation is probably due to a correlation between blossom color and seed-coat colors or color patterns. Another thing that calls for explanation is the occurrence of light pink flowers in the second generations in Table 4. These appear in a majority of the crosses but not in all of them. There can be little reason to doubt that nearly all, at least, of these classifications of blossom color are correct, for our policy has been not to record a departure from expectation in any case of doubt, but only where the unexpected character is reasonably typical. As previously explained, these two color types are quite distinct. It may be observed that White Marrow gives peculiar results here as in crosses already discussed. It is probable that the appearance of the light pink blossoms in these crosses is connected with the pigmentation of the seed-coat, and may be explained by a study of the seed-coat color. White Marrow evidently carries several factors modifying pigmentation both of seed-coat and blossom.

TABLE 3. — *Pink and White.*

	F_1.	F_2.				F_3 and F_4.				
						White Parents.		Pink Parents.		
		White.	Light Pink.	Pink.	Total.	White.	Pink.	White.	Pink.	Total.
Challenge Black Wax × Davis Wax,	Pink,	84	5	245	334	-	-	0 8	11 19	11 27
Challenge Black Wax × Golden-eyed Wax,	Pink,	73	14	107	194	69	0	0 9	56 16	56 25
Challenge Black Wax × Creaseback,	Pink,	82	4	367	453	-	-	0 9	19 33	19 42
Golden-eyed Wax × Currie,	Pink,	99	10	140	249	55	0	0 39	34 33	34 79[1]
Currie × Red Valentine,	Pink,	43	26	71	140	65	0	0 13	114 11	114 24
Red Valentine × Currie,	-	103	7	292	402	185	0	0 33	143 100	143 133
Currie × White Marrow,	-	38	0	67	105	225	0	0 48	30 135	30 231[2]
Golden-eyed Wax × Prolific Black Wax,	-	19	0	28	47	94	0	0 10	4 21	4 31
Creaseback × Prolific Black Wax,	Pink,	15	0	25	40	-	-	-	-	-

[1] Also 6 light pink and 1 crimson.

[2] Also 8 light pink.

TABLE 4. — *Pink and White.*

		F_2.				F_3 AND F_4.											
						WHITE PARENTS.				LIGHT PINK PARENTS.				PINK PARENTS.			
	F_1.	White.	Light Pink.	Pink.	Total.	White.	Light Pink.	Pink.	Total.	White.	Light Pink.	Pink.	Total.	White.	Light Pink.	Pink.	Total.
White Marrow × German Black Wax,	Pink, .	27	27	44	98	31	0	0	31	4	13	0	17	0	7	5	12
										0	2	9	11	9	11	10	30
						54	13	0	67	23	1	0	24	0	0	34	34
Prolific Black Wax × Red Valentine,	–	13	12	21	46	2	0	5	7	14	0	10	24	17	0	55	72
						158	0	0	158	5	2	6	13	25	7	45	77
														0	0	42	42
Red Valentine × Prolific Black Wax,	Pink, .	60	170	42	272	128	0	0	128	2	0	3	5	7	0	25	32
		9	0	18	27					0	3	6	9	0	1	5	6
										0	0	28	28	11	8	34	53
White Marrow × Prolific Black Wax,		2	0	10	12	60	0	0	60	1	1	1	3	24	0	82	106

In Table 5 are shown the results of crossing various white-flowered varieties with Blue Pod Butter, the one crimson-flowered variety under observation. The results of these crosses present several unexpected complications. The most striking is the new and distinct blossom color designated as "waxy pink." This resembles the light pink more than any of the other colors, the amount of coloration being about the same, but its distribution is different, being heaviest on the outer part of the banner petal. It carries no suggestion of purple, and the entire plant has a waxy-yellow tinge distinct from the deeper green of the other plants. It will be noted that this type appears in all crosses of Blue Pod Butter, given in Table 5, except those with Davis Wax and Creaseback. It also appears in all crosses of Blue Pod Butter with varieties having light pink flowers shown in Table 7, but appears in none of the crosses with pink-flowered black-seeded varieties given in Table 8. It must be regarded as resulting from a cross of Blue Pod Butter with some, but not all, white or light pink-flowered varieties.

TABLE 5. — *Crimson and White.*

	F_1.	F_2.						F_3 and F_4.											
								White Parents.						Light Pink Parents.					
		White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.
Blue Pod Butter × Davis Wax, .	Crimson, .	7	0	9	11	0	27	-	-	-	-	-	-	-	-	-	-	-	-
Davis Wax × Blue Pod Butter, .	Crimson, .	17	0	11	41	0	69	-	-	-	-	-	-	-	-	-	-	-	-
Blue Pod Butter × Golden-eyed Wax,	4 crimson, 1 pink.	17	3	7	21	7	55	-	-	-	-	-	-	-	-	-	-	-	-
Golden-eyed Wax × Blue Pod Butter,	Crimson, .	24	0	5	23	8	60	5 6	0 0	0 0	0 1	0 1	5 8	-	-	-	-	-	-
Blue Pod Butter × Red Valentine, .	Pink, .	8	3	5	31	2	49	-	-	-	-	-	-	-	-	-	-	-	-
Blue Pod Butter × Wardwell, . .	Pink, . .	12	3	6	16	3	40	5	0	1	0	0	6	3	4	0	0	4	11
Wardwell × Blue Pod Butter, . .	Pink, . .	14	7	11	18	5	55	8	0	0	0	0	8	-	-	-	-	-	-
Blue Pod Butter × Creaseback, .	Crimson, .	71	2	28	137	0	241	-	-	-	-	-	-	-	-	-	-	-	-
Creaseback × Blue Pod Butter, .	Crimson, .	37	1	9	77	0	124	-	-	-	-	-	-	-	-	-	-	-	-
Blue Pod Butter × White Marrow, .	30 crimson, 5 pink.	26 13 14	0 14 6	1 17 7	27 35 25	4 6 7	58 81 59	254 12 31	0 0 2	0 10 0	0 0 0	0 0 26	254 22 59	3 0 0	0 0 2	10 8 1	0 0 1	0 0 5	13 8 9
White Marrow × Blue Pod Butter, .	Crimson, .	3 12	4 4	6 5	4 23	0 7	17 51	5	0	0	0	0	5	3	1	0	0	0	4

TABLE 5. — *Crimson and White* — Concluded.

	F₃ and F₄ — *Con.*																	
	PINK PARENTS.						CRIMSON PARENTS.						WAXY PINK PARENTS.					
	White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	White.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.
Blue Pod Butter × Davis Wax,	0	0	17	0	0	17	0	0	0	5	0	5	-	-	-	-	-	-
	3	0	16	0	0	19	3	0	1	2	0	6						
Davis Wax × Blue Pod Butter,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blue Pod Butter × Golden-eyed Wax,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Golden-eyed Wax × Blue Pod Butter,	2	1	6	1	0	10	0	0	0	6	0	6						
	5	0	14	0	0	19	4	0	1	3	0	8	4	0	0	0	7	11
							5	0	2	3	1	11						
Blue Pod Butter × Red Valentine,	-	-	-	-	-	-	0	1	1	8	1	11	-	-	-	-	-	-
							0	0	6	11	0	17						
Blue Pod Butter × Wardwell,	-	-	-	-	-	-	0	0	4	4	2	10	-	-	-	-	-	-
							0	1	1	11	3	16						
							4	0	2	4	0	10						
Wardwell × Blue Pod Butter,	3	1	8	0	0	12	5	1	7	14	1	28	0	3	0	0	3	6
	0	0	10	0	0	10	0	0	4	13	0	17						
Blue Pod Butter × Creaseback,	6	1	27	0	0	34	6	0	0	44	0	50	-	-	-	-	-	-
	3	0	7	2	0	12	23	0	12	59	0	94						
Creaseback × Blue Pod Butter,	-	-	-	-	-	-	7	0	0	23	0	30	-	-	-	-	-	-
							2	0	4	5	0	11						
							0	0	0	8	0	8						
							0	0	3	17	0	20						
							0	3	4	5	0	12						
	0	0	10	0	0	10	4	0	0	13	0	17						
Blue Pod Butter × White Marrow,	0	0	2	0	21	23	12	0	9	30	0	51	7	0	0	0	15	22
	2	1	6	0	0	9	0	0	0	8	2	10	2	0	0	1	1	4
	49	0	117	0	0	166	0	0	4	4	1	9						
							7	0	0	6	2	15						
							4	1	5	12	0	22						
White Marrow × Blue Pod Butter,	0	2	5	0	0	7	0	0	0	3	4	7	0	1	0	0	4	5

In the third and fourth generations from the cross it appears commonly among the progeny of light pink and crimson parents, and in two cases from white-flowered parent plants, and in one case from a pink-flowered parent. It is probable that these three cases should be regarded as exceptional, and it is possible that one or two may arise from erroneous observations. When self-fertilized it commonly breeds true, or it may yield light pink or white progeny. In one case it yields one crimson-flowered plant. There have been several cases where such plants have appeared most unexpectedly from parent plants of lighter-colored flowers, a thing that we are unable to explain unless they be regarded as mutants.

Light pink flowers appear in all crosses of Table 5, except the one with Davis, and pink flowers in all of them.

A study of the ratios of these several blossom colors leads only to confusion. It is probable that the theoretical ratios differ in the different crosses, and, as in many other cases, are correlated with the seed-coat pigmentation.

Table 6 gives the results of crossing pink and light pink-flowered varieties. Only the parent types appear, as a rule; the pink is uniformly dominant, and the proportions, while departing considerably in some cases from the expected ratio of 3:1, are perhaps not further than might be expected.

TABLE 6. — *Pink and Light Pink.*

	F1.	F2.			F3 and F4.					
					LIGHT PINK PARENTS.			PINK PARENTS.		
		Light Pink.	Pink.	Total.	Light Pink.	Pink.	Total.	Light Pink.	Pink.	Total.
Burpee Stringless × German Black Wax,	Pink,	17	79	96	131	0	131	0	104	104
					2	2	4	19	61	80
German Black Wax × Burpee Stringless,	Pink,	25	48	73	20	0	20	0	111	111
					36	68	104	37	56	93
Burpee Stringless × Prolific Black Wax,	Pink,	16	8	24	8	0	8	0	6	6
					2	1	3	2	11	13
Warwick × Challenge Black Wax,	Pink,	10	6	16	257	0	257	0	100	100
								7	34	41
Challenge Black Wax × Warwick,	Pink,	9	20	29	-	-	-	-	-	-
Currie × Mohawk,	Pink,	97	202	300[1]	199	0	199[2]	0	56	56
								8	19	27
Mohawk × Currie,	Pink,	16	22	38	-	-	-	-	-	-
Prolific Black Wax × Mohawk,	-	0	3	3	-	-	-	14	45	59

[1] Also 1 white flower.

[2] One light pink parent gave 21 white, see text.

There are, however, a few irregularities. One is the appearance in F_3 and F_4 of pink-flowered plants from light pink parents, and another is the appearance of white-flowered plants in the cross of Currie × Mohawk. The single white-flowered plant in F_2 was covered with a muslin bag for self-fertilizing which may have suppressed the color, but the 21 whites from a light pink parent cannot be thus accounted for; they bred true in the succeeding generations so far as flower color was concerned.

TABLE 7. — *Crimson and Light Pink.*

	F₁.	F₂.					F₃ and F₄.																	
							Light Pink Parents.					Pink Parents.					Crimson Parents.					Waxy Pink Parents.		
		Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	Light Pink.	Pink.	Crimson.	Waxy Pink.	Total.	Light Pink.	Waxy Pink.	Total.
Blue Pod Butter X Burpee Stringless,	Crimson,	33 16	23 34	78 64	3 1	137 115	120 0 71	0 0 0	0 0 0	0 41 55	120 41 127[1]	0 15	7 28	0 0	0 0	7 43	0 0 0 1 0 3	0 19 8 0 0 4	139 33 43 16 11 9	0 0 1 4 1 1	139 52 52 21 12 17	0	44	44
Burpee Stringless X Blue Pod Butter,	Crimson,	17 6	24 20	60 46	0 5	101 77	2 32	0 0	0 0	0 12	2 44	0 9	27 36	0 0	0 0	27 45	0	0	18	0	18	–	–	–
Blue Pod Butter X Giant Stringless,	Crimson,	6	2	8	1	17	5	0	0	6	11	2	17	0	0	19	1	2	9	0	12	–	–	–
Giant Stringless X Blue Pod Butter,	Crimson,	8	15	35	11	69	–	–	–	–	–	2	0	0	0	2	0	1	7	0	8	–	–	–
Blue Pod Butter X Mohawk,	Crimson,	3	1	3	2	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mohawk X Blue Pod Butter,	Crimson,	1	3	9	1	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Blue Pod Butter X Warwick,	Crimson,	7	12	23	9	51	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Warwick X Blue Pod Butter,	Crimson,	28	33	87	21	169	32	0	0	0	32	0 25	5 30	0 0	0 0	5 55	0 1	0 1	30 2	14 2	44 6	0 3	51 16	51 19
Low Champion X Blue Pod Butter,	Crimson,	7	11	38	6	62	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[1] Also 1 white.

The crosses of Blue Pod Butter, the crimson-flowered varieties given in Table 7, have been already discussed in connection with Table 5. Only one white-flowered plant appeared among those crosses, and that was in the F_3 generation of Blue Pod Butter × Burpee Stringless. No reason for its appearance can be assigned.

Table 8 gives the results of crossing Blue Pod Butter with pink-flowered black-seeded sorts. As already stated none of the waxy-pink flowers appear among these crosses. White flowers appear among the progeny of the crosses of Blue Pod Butter × German Black Wax, but not in the reciprocal cross, also in the cross of Currie and Blue Pod Butter. Light pink flowers appear rarely, and they may be extreme variants of pink flowers in which the color has been partially suppressed by environmental conditions.

TABLE 8. — *Crimson and Pink.*

		F2.					F3 and F4.									
							PINK PARENTS.					CRIMSON PARENTS.				
	F1.	White.	Light Pink.	Pink.	Crimson.	Total.	White.	Light Pink.	Pink.	Crimson.	Total.	White.	Light Pink.	Pink.	Crimson.	Total.
Blue Pod Butter × Challenge Black Wax, .	Crimson,	0	2	20	56	78	-	-	-	-	-	-	-	-	-	-
Challenge Black Wax × Blue Pod Butter, .	Crimson,	0	0	67	170	237	0 0	0 1	59 1	0 7	59 9	0 0 0	0 0 1	0 4 3	17 15 15	17 19 19
Blue Pod Butter × Currie, ...	Crimson,	0	0	8	48	56	-	-	-	-	-	-	-	-	-	-
Currie × Blue Pod Butter, ...	Crimson,	0	4	89	156	249	0 2 5	0 0 4	35 3 18	0 0 0	35 5 27	0 0 2	0 0 9	0 7 3	14 43 9	14 50 23
Blue Pod Butter × German Black Wax, .	Crimson,	10 0	0 0	12 9	31 25	53 34	0 7	0 0	10 20	0 0	10 27	0 6 2	0 0 1	0 4 2	13 13 9	13 23 14
German Black Wax × Blue Pod Butter, .	Crimson,	0	0	17	59	76	0 0 0	0 1 0	6 19 6	0 0 22	6 20 28	0	0	14	25	39
Blue Pod Butter × Prolific Black Wax, .	Crimson,	0	0	56	141	197	0	0	108	0	108	0 0	0 0	0 10	38 10	38 20
Prolific Black Wax × Blue Pod Butter, .	Crimson,	0	0	32	112	144	0	0	27	0	27	0	0	0	25	25

It is the usual expectation that when two white-flowered varieties are crossed only white flowers should result. Table 9 shows that in beans this is by no means true. It comprises all such crosses save one, Wardwell × Golden-eyed Wax, which has been bred for three generations from the cross, yielding about 100 plants, with none but white flowers appearing. All the rest of such crosses have yielded colored flowers in each generation bred. All these crosses involve varieties one or both of which bear pigmented seeds, these adding further evidence that blossom color is governed largely by the pigmentation of the seed coat.

TABLE 9. — *White and White.*

	F₁.	F₂. White.	F₂. Light Pink.	F₂. Pink.	F₂. Total.	F₃ and F₄. White parents. White.	Light Pink.	Pink.	Total.	Light pink parents. White.	Light Pink.	Pink.	Total.	Pink parents. White.	Light Pink.	Pink.	Total.
Red Valentine × Golden-eyed Wax,	–	16 175 8	16 0 28	0 0 2	32 175 38	169 1	0 3	0 10	169 14	0 0 3 3	4 0 12 0	0 6 0 8	4 6 15 11	0 1 4	0 1 0	38 14 21	38 16 25
Golden-eyed Wax × Red Valentine,	White,	61	5	0	66	–	–	–	–	–	–	–	–	–	–	–	–
Red Valentine × Keeney Rustless,	Pink,	6 12	11 0	0 24	17 36	33	0	0	33	16	0	23	39	0 10	0 0	5 33	5 43
Red Valentine × White Marrow,	2 light pink, 2 pink.	47 19 28	0 36 29	0 0 1	47 55 58	165 20	0 16	0 0	165 36	0 10	33 13	0 0	33 23	–	–	–	–
White Marrow × Red Valentine,	–	6	11	0	17	65	0	0	65	7	0	12	19	0	0	57	57
Golden-eyed Wax × Creaseback,	–	15	0	13	28	5	0	0	5	–	–	–	–	69	0	65	134
Golden-eyed Wax × White Marrow,	–	40 34	56 2	0 0	96 36	9	0	0	9	10	38	0	48	–	–	–	–
White Marrow × Golden-eyed Wax,	–	12	11	0	23	15 41	0 22	0 0	15 63	–	–	–	–	–	–	–	–
Wardwell × Keeney Rustless,	Light pink,	16	0	0	16	88 10	0 0	0 3	88 13	–	–	–	–	–	–	–	–
White Marrow × Keeney Rustless,	–	15	8	0	23	30	0	0	30	26	17	0	43	–	–	–	–
Wardwell × White Marrow,	Light pink,	12 13	9 1	0 16	21 30	38	0	0	38	–	–	–	–	12	3	16	31
Davis Wax × Keeney Rustless,	Pink,	6	0	15	21	–	–	–	–	–	–	–	–	–	–	–	–

The following crosses of two light pink flowered varieties gave only light pink flowered plants in the progeny.

Golden Carmine × Mohawk.
Mohawk × Golden Carmine.
Burpee Stringless × Giant Stringless.
Mohawk × Burpee Stringless.
Giant Stringless × Mohawk.
Mohawk × Giant Stringless.

One cross of Warren × Burpee Stringless gave, in F_2, 6 light pink, 3 pink, 13 crimson and 2 waxy pink, the F_1 plants being light pink. It should be said that while both of these varieties are classed as light pink they are not identical in the appearance of the blossom color. Only one cross of pink-flowered varieties has been made, — Challenge Black Wax × Prolific Black Wax. All the resulting plants have borne only pink flowers.

In this paper we have attempted little more than setting forth some of the facts concerning the inheritance of blossom color that have appeared in the work of the past five years. Beyond doubt the interpretation of these results is to be made through an analysis of the records of the inheritance of seed-coat color. It is hoped that this work may be accomplished, including another season's observation, in time for presentation in the next annual report of the experiment station.

DEPARTMENT OF VETERINARY SCIENCE.

REPORT OF THE VETERINARIAN.

JAS. B. PAIGE, D.V.S.

During the past year the policies of former years in dealing with the work in this department have been adhered to. The personnel of the department is the same as last year. With the addition of Dr. G. E. Gage to the working force it has seemed possible to devote more time to investigation problems than in former years, when one man had to attend to the entire work of the department of both college and experiment station. Owing to the demands of a larger number of students in some of the classes, and an increase in the amount of instruction given, it has been found that much of the time of an additional assistant has been utilized, not for investigational work as had been expected, but for teaching.

If the veterinary department of the experiment station is to render such service to the stock owners of the State as they are justly entitled to, it is imperative that a competent pathologist, who shall devote practically all his time to investigational problems, be added to the staff of the department at the earliest possible date.

There are numerous important problems that call for immediate and thorough study. Some of these studies promise the most flattering results from a practical and economic standpoint in the prevention, cure or eradication of animal diseases.

During the year there has been the usual amount of correspondence with farmers from all parts of the State relative to the existence and treatment of disease of farm animals. This correspondence is fruitful of the best results in many instances. It is often possible, from the information received from a stock

owner by letter, to diagnose the disease of his animal and to advise a line of treatment that will lead to a cure of it. At other times, additional information may be requested or a specimen asked for, which, received and examined, enables us to arrive at a correct diagnosis upon which a successful course of treatment for the individual animal or for an entire herd is based.

The diagnosis work that is carried on each year is gradually increasing. It is closely correlated with the correspondence mentioned above. Frequently specimens are sent by farmers direct to the department, with a request that an examination be made, and a report as to the nature of the disease, its cause, prevention or cure returned. At times material from sick or dead animals is sent upon request of the department when a positive diagnosis cannot be made from information obtained by letter from the owner of the animal. Since Jan. 1, 1912, approximately 100 specimens have been received, examined and information returned to the senders of them with advice as to course of treatment to be followed in dealing with the several diseases. This diagnosis work is not only beneficial to the farmers, enabling them in many instances to avail themselves of the services of the station veterinarian, but it is of value to the department, as it provides a means by which we are kept in touch with the various ailments of farm animals throughout the State. In addition, the material received from different sections of the State furnishes, at times, valuable material for demonstrations with the students taking the courses in veterinary science and pathology.

It frequently happens that valuable material for study is received from stock owners. Through specimens that have been received we have on several occasions been able to diagnose the existence of animal diseases in Massachusetts that were not supposed to exist here, and also we have found disease not previously described. As good examples of these may be mentioned verminous bronchitis of sheep and a peculiar paralytic disease of fowls.

Among some of the more interesting specimens that have come to the department during the year may be mentioned verminous bronchitis of sheep; necrotic stomatitis of calf; trau-

matic pericarditis of steer; purulent endometritis and uterine torsion of cow; cholera and demodectic scabies of the pig; traumatic peritonitis, due to perforation of gizzard of fowl with wire nail; variola; fatty infiltration of liver of fowl; and bacillary white diarrhœa of chicks. Several samples of milk, contaminated with special species of bacteria causing such abnormal conditions as "curdled," "bitter" and "gassy" milk, have been received and examined, and advice given as to how the trouble could best be eliminated and prevented.

Whenever the seriousness and nature of an outbreak of disease seems to warrant it a visit is made to the farm where the trouble makes its appearance, for the purpose of making a critical study of conditions under which the disease of the animals has developed and exists. In such cases, in order not to encroach upon the field and practice of the local veterinarian, provided there is one in the locality, the visit is usually made in company with the local practitioner.

Another field in which the department has been able to render some service to the stockmen of the State has been in the examination of stables and advising with reference to the improvement of sanitary conditions. This has not only been done with stables already constructed, but also, in some instances, plans of proposed stables have been submitted for examination and suggestions.

As already mentioned, the department has not been able to carry on as much original investigation as it desired on account of the amount of teaching that it has been necessary to do. This has been due, in part, to the fact that we have taught throughout the year the courses in bacteriology that eventually will be taken over into the new department of microbiology, created by trustee vote last year, and to which Dr. C. E. Marshall was elected the head. When we are relieved of this line of teaching it is hoped that more time can be given to investigation problems. It will not, however, completely remedy the difficulty, as courses in pathology will be introduced into the curriculum that will be carried by this department. While these will not be as time-consuming as the work in bacteriology, they will interfere sufficiently with the class of investigational work that is demanded to warrant the employment of a pathologist on the

experiment station staff who shall be able to devote practically his entire time to the study of pathological problems that are pressing for solution.

As mentioned in the report of last year, there is an unusual amount of hog cholera in the State as compared with former years. It is assuming alarming proportions, more especially in herds fed upon "city" swill or garbage. Its cause in these herds is to be attributed to an infection following the ingestion of uncooked pork scrap, from sources where cholera exists, that finds its way into the swill barrel of the hotel, boarding house or private house, and finally to the trough of the hogs. Once an animal of the herd becomes affected it spreads contagion rapidly to healthy animals with which it is kept.

The department, in co-operation with Mr. Fred F. Walker, Commissioner of the Department of Animal Industry, under whose jurisdiction all contagious animal diseases come, has undertaken some investigations to determine more accurate methods for the diagnosis of cholera in the hog, and its cure and control by the use of anti-hog cholera serum.

In December last, in company with Mr. Walker, I attended the meeting of the State live stock sanitary boards at Chicago, where means and methods for the preparation of serum and the control of the disease were fully discussed by the highest authorities in the country. Since then serum has been used upon several lots of hogs, in which cholera was known to exist, to determine its value as a curative and preventive agent. The herds are located in the middle part of the State so as to permit of occasional inspection without the sacrifice of too much time.

While the work upon hog cholera has not progressed sufficiently to warrant a full report at this time, I feel justified in predicting that by the use of properly prepared serum, under certain conditions, we shall be able to greatly lessen the annual loss to the swine owners from this disease, and in the end succeed in protecting against its ravages to the extent that it may be made one of the most profitable branches of animal industry in the Commonwealth.

Already steps have been taken to prepare, in an experimental way, small quantities of anti-hog cholera serum in the department. If the results of the experiment seem to warrant it, it

is possible that in the near future the experiment station may be justified in preparing the serum on a sufficiently large scale to enable it to be distributed at a slight cost, sufficient to pay the actual cost of production, to the hog owners of the State. Should this be done it would be necessary to co-operate with the Department of Animal Industry.

Some years ago, working with the Chief of the Cattle Bureau, of the State Board of Agriculture, the department organized the work for the prevention of black leg in cattle by the use of vaccine, obtained from the Bureau of Animal Industry of the Federal Department of Agriculture. The supervision of the work is still in the veterinary department, in a general way, but no time is given to the actual vaccination of animals about the State, this being done by the special agent of the present Department of Animal Industry.

Although Dr. George E. Gage, assistant professor of animal pathology of the veterinary department, receives no compensation from the experiment station, he has devoted as much time as his teaching duties would permit to the investigation of several important avian diseases, among which is one that appears, from the work already done, never to have been described before. The study of this obscure and interesting disease is being carried along as rapidly as possible under existing conditions, and it is hoped that at a later date the details of the investigation will be brought out in bulletin form.

REPORT OF CRANBERRY SUBSTATION FOR 1912.

H. J. FRANKLIN.

The experiments conducted and observations made during the year may be discussed under the eight following heads: weather observations, frost protection, fungous diseases, varieties, blossom pollination, fertilizers, insects and miscellaneous.

1. Weather Observations.

The season's observations began late in April, the Weather Bureau having at this time installed the following instruments at the station bog: elevated instrument shelter, thermograph, barograph, hygrograph, triple register (for sunshine, wind direction and wind velocity) with battery and wiring, weather vane, anemometer, rain gauge, psychrometer, two maximum and four minimum thermometers and a sunshine recorder.

With these instruments the first really thorough and serious year's work in investigating Cape Cod frost conditions, in their relations to cranberry culture, was carried out. An unusually large number of frosty nights during the first part of the season, especially in June, favored this investigation, and as a result much valuable information was accumulated. It now seems that it may in time be possible to forecast frosts with gratifying accuracy. The Southern Massachusetts Telephone Company has considerably improved its distribution of the frost warnings sent out from Boston by the district forecaster of the Weather Bureau. In addition to these warnings the substation has undertaken to make special early evening forecasts for the benefit of any who may wish to telephone in for them on doubtful nights. It is not expected that the growers will place full reliance on these forecasts at present, but it is hoped that they

may be of assistance in case of doubt, and that they may in time become fully reliable. However, there is so much at stake when a bog promises a good crop that it will probably be best for the growers to provide themselves with the necessary instruments and learn to make their own forecasts, because there is such a variety of conditions in different parts of the Cape.

The season's records seem to show that the early evening dew point, which has been shown to be of no value as an indicator of the minimum night temperature in some parts of the country, can be relied upon to a considerable extent in forecasting such temperatures on the Cape. The records further seem to show that the best indications that a frost may be expected on any night during the usual period of frost danger are the following: —

1. Low dew point (50° F. or below at substation shelter).
2. High (above 30) and rising barometer.
3. An all day's wind from a northerly, northeasterly or northwesterly direction, dying out in the early evening.
4. A clear sky.
5. A low maximum day temperature.
6. A low and falling early evening temperature.

The readings of the maximum and minimum thermometers and the amount of precipitation were telegraphed to the office of the United States Weather Bureau at Boston every morning after April 25 during the spring and fall periods of frost danger.

2. Frost Protection.

Because of the failure of a circulating pump, it was impossible to carry out tests with the Skinner system, as had been planned, during the spring frost period. Certain apparent disadvantages connected with the use of this system for frost protection have been discovered. In the first place, the pump and engine required for supplying water under the necessary pressure for a system covering several acres are more expensive than at first supposed. The Skinner Irrigation Company states that it is necessary to sprinkle most crops with water every two minutes during a frosty night in order to afford sufficient protection. It seems possible, however, that the injury caused by frost may be prevented by sprinkling the frosted plants

with water at about sunrise, and so drawing the frost out of them gradually before the heat of the sun strikes them. Frost injury appears to be caused not by the freezing but by too rapid withdrawal of the frost. If this is true, it may be possible to sprinkle a cranberry bog with the Skinner system, or some other similar system, a section at a time, and so provide protection for the whole bog with an engine and pump only large enough to pump water for one section. Experiments have been planned to test the practicability of this method.

Another drawback to the Skinner system is the clogging of the nozzles. This gave much trouble in the small system installed at the station bog, and market gardeners who have had long experience with this system meet the same difficulty. Because of this it is now planned to test another system, which has been devised for the same purpose, with rotating nozzles set far apart and large enough to allow small particles in the water to pass through them instead of clogging.

Two extensive tests with 65 3-gallon Hamilton orchard heaters were carried out in the late fall and early winter. These tests showed that it is possible to raise the temperature sufficiently to protect from frost by means of these heaters, but the expense connected with their use seems to be so great that this method of protection cannot be considered practicable with fuel oil at the present price. The heaters were loaned to the substation by the Hamilton Orchard Heater Company, through the courtesy of its local agent, Mr. Chester D. Holmes of Plymouth, Mass.

3. Fungous Diseases.

As in previous years, this work was carried on in co-operation with the Bureau of Plant Industry of the United States Department of Agriculture. Dr. C. L. Shear of that Bureau has done much laboratory work and has had general supervision of the spraying experiments, having kept in touch with the work on the bogs by several trips to the Cape. Co-operative spraying tests were carried on by several growers. The five plots, each four rods square, which were sprayed in the season of 1911, as reported in the last annual report of the station, were sprayed again in 1912 on dates and with fungicides as follows: —

TABLE I.

FUNGICIDE.	Plot A.	Plot B.	Plot C.	Plot D.	Plot E.
Bordeaux mixture, . . .	June 28	June 28	June 29	June 29	June 29
Bordeaux mixture, . . .	July 17	July 17	July 18	July 18	July 18
Neutral copper acetate, . .	August 5	August 5	August 6	August 6	August 6

The Bordeaux mixture was made up of 3 pounds of lime and 4 pounds of copper sulfate to 50 gallons of water. One pound of the neutral copper acetate was used to 50 gallons of water. Two pounds of resin fish-oil soap were used with the Bordeaux mixture in all cases and with the acetate.

The crop was gathered from these plots and their checks on dates and in amounts as follows, the quantities being given in bushels: —

TABLE II.

PLOT.	Area (Square Rods).	Date when picked.	Variety.	Quantity of Fruit (Bushels).	Quantity per Square Rod (Bushels).	Average of Double Checks per Square Rod.	Per Cent. of Increase due to Spraying.
A, . .	16	Sept. 19	Howe.	7⅛	.4453	-	144+
A check 1, .	4½	Sept. 19	Howe.	¾	.1667	.1823	-
A check 2, .	8	Sept. 19	Howe.	1 7/12	.1979		
B, . .	14⅛	Sept. 12	McFarlin.	7	.4956	-	45+
B check, .	13⅔	Sept. 12	McFarlin.	4⅔	.3415	-	-
C, . .	16	Sept. 19	Howe.	6⅙	.3854	-	86⅗
C check 1, .	4	Sept. 19	Howe.	⅞	.2187	.2065	-
C check 2, .	12	Sept. 19	Howe.	2⅓	.1944		
D, . .	16	Sept. 12	Early Black.	10⅓	.6458	-	47⅗
D check, .	8	Sept. 12	Early Black.	3½	.4375	-	-
E, . .	16	Sept. 7	Early Black.	7¾	.4844	-	55+
E check 1, .	8	Sept. 7	Early Black.	2½	.3125	.3125	-
E check 2, .	4	Sept. 7	Early Black.	1¼	.3125		

It will be noted from this table that the results of the spraying were far more marked with the Howe variety than with either of the others. Moreover, Plot A showed a much greater increase than the other Howe plot. The only difference in the

treatment of the two Howe plots was that Plot A was sprayed three times during 1911, while Plot C, as well as the other plots, was sprayed only twice.

Where two checks were laid out for the same plot (as noted in the above table) they were in every case located on opposite sides of the sprayed area. The berries were all picked with scoops. It should be borne in mind that the increases recorded above were obtained in spite of considerable mechanical injury done in the process of spraying. The spraying was done with a 30-gallon wheeled-barrel outfit, and the injury was much greater than it would have been had a power outfit been used, it being serious enough to be plainly noticeable on the vines, on parts of the plots, at picking time.

It should be noted here that the fungus plots showed no increase in quantity of fruit over their checks last year, and this may perhaps be taken to indicate that the effects of annual spraying are cumulative.

The increase in quantity of fruit on the McFarlin plot was accompanied by a much more light-colored and sickly appearance to the foliage than was shown by the vines of the check plot. The contrast between the sprayed and unsprayed vines in this respect was noticeable by the 1st of September, and very marked after the crop was picked, being plainly evident to the eye from a long distance. A redder and more sickly color was also distinctly evident on the two Early Black plots as compared with the surrounding unsprayed vines, but the contrast was not nearly so great as with the McFarlin plot. No such difference was apparent on the Howe vines, possibly because it was hidden by the naturally very dark color of their foliage. The McFarlin and Early Black vines seemed to show that there was not sufficient available plant food present to maintain a strong vine condition and at the same time develop the extra amount of fruit which the reduction of fungous diseases by the spraying had made possible. Possibly the effects of fungus spraying are often limited by such a lack, and combination experiments with fungus spraying and fertilizers have been planned to determine this point.

When the fruit was gathered no distinct difference in color between the berries from the sprayed plots and their checks

was observed. The berries from Plots A and C were somewhat larger than those from their checks, as shown by the following averages of counts of berries of 6 cupful samples (New England Cranberry Sales Company's inspector's cup) from each plot and its check, the samples being in each case taken as evenly as possible from the various boxes: —

		Number of Berries.
Plot A.	Average of first 6 samples,	100
	Average of second 6 samples,	105
Check A.	Average of first 6 samples,	110
	Average of second 6 samples,	104
Plot C.	Average of first 6 samples,	104
	Average of second 6 samples,	108½
Check C.	Average of first 6 samples,	112
	Average of second 6 samples,	111

The berries from the McFarlin plot showed practically no difference in size from those of the check, as is evident from the following averages of 6 samples taken in the same way: —

		Number of Berries.
Plot B.	Average of first 6 samples,	67
	Average of second 6 samples,	72
Check B.	Average of first 6 samples,	68
	Average of second 6 samples,	71

Of the Early Black plots, Plot D and its check showed practically no difference in the sizes of their berries, as is shown by the following averages of counts of 6 samples: —

		Number of Berries.
Plot D.	Average of first 6 samples,	110
	Average of second 6 samples,	109
Check D.	Average of first 6 samples,	111
	Average of second 6 samples,	109

The berries from Plot E were distinctly smaller than those from its checks, as is shown by the following averages: —

		Number of Berries.
Plot E.	Average of first 6 samples,	120
	Average of second 6 samples,	123
Check E.	Average of first 6 samples,	113
	Average of second 6 samples,	109

It should be noted here that the time of picking, apparently, had something to do with the relative size of the berries from these plots and their checks, for Plot E, picked on September 7, produced smaller berries than its checks, and Plots B and D, picked on September 12, produced berries of the same size as their checks, while Plots A and C, picked on September 19, produced larger berries than their checks, a gradation according to dates, irrespective of variety, thus being evident. This was perhaps caused by a retardation in the development of the fruit on the sprayed vines, due to the heavier crop which they were producing.

The keeping qualities of the berries from these plots and their checks were tested, with the results shown in the following table: —

TABLE III.

PLOT.	Test begun.	Test ended.	Quantity tested (Boxes).	Quantity of Sound Fruit after Screening (Boxes).	Percentage of Loss.
A,	Oct. 3	Dec. 16	3	2⅝	12½
Check A,	Oct. 3	Dec. 16	2	1½	25
B,	Oct. 11	Dec. 16	2⅔	2 7/64	21
Check B,	Oct. 11	Dec. 16	2⅓	1 9/16	33
C,	Oct. 11	Dec. 17	4	3 19/32	10
Check C,	Oct. 11	Dec. 16	2⅔	2 7/64	21
D,	Oct. 11	Dec. 16	3	2 17/32	15⅗
Check D,	Oct. 11	Dec. 16	2⅔	2 3/16	18
E,	Oct. 11	Dec. 16	3⅓	2 23/32	18⅖
Check E,	Oct. 11	Dec. 16	2⅓	1 13/16	22⅓

The boxes used were bushel boxes, but a few slightly smaller boxes got mixed in and were not noticed until too late, causing an error to creep in which undoubtedly affected the percentages somewhat, though it is impossible to say how much. The berries were run through the separator at the beginning of the tests, but were not screened until the final screening on December 16 and 17. For these tests the berries of the two checks of those plots which had double checks (A, C and E) were mixed to form a single check for each plot.

It will be noted that Table III. shows a much greater improvement of keeping quality, due to the spraying, with the Howe berries (A and C) than with either the Early Blacks (D and E) or the McFarlins (B). This and the distinctly greater increase in quantity of fruit on the Howe plots indicate the presence of a special diseased condition, affecting that variety, which was either much less in amount or absent altogether on the McFarlins and Early Blacks. While there was much more hypertrophy ("false blossom") on the Howe vines during the first part of the summer than on the vines of the other varieties, it does not appear that this was the cause of the difference in the results obtained from spraying, for it has not been shown that spraying affects this disease. The difference seems to have been due to the presence of a hitherto unknown disease (as Dr. Shear has determined) which, for convenience, we will tentatively call the "blossom end rot." This disease was the most evident cause of decay among the Howe berries from the station bog in the fall of 1911 and also of 1912. It was only occasionally found, however, on the berries of the other varieties. Its characteristic effect on the fruit is to cause it to rot, beginning at the blossom end and working gradually toward the stem end, the berry becoming soft but remaining plump and watery, as the decay progresses. In an early stage of this rotting a characteristic, yellowish brown discoloration appears at or near the blossom end of the berry and remains there without much extension until the whole berry becomes soft. That the presence of this disease was the cause of the difference in the results obtained by spraying is shown by the following averages of counts of decayed berries in samples taken at random from the boxes of the storage tests (6 samples examined for each average), classified according to the apparent primary causes of the decay: —

TABLE IV.

[These examinations and counts were made on November 12.]

CAUSES OF DECAY.	PLOT A.		CHECK A.		PLOT C.		CHECK C.	
	First Average.	Second Average.	First Average.	Second Average.	First Average.	Second Average.	First Average.	Second Average.
Blossom end rot,	1⅔	3	6	1½	1	1	5	9
Injury,	-	1	3	1½	1	3	-	2
Doubtful,	2⅓	2	1	2	1	1½	-	3

Table III. indicates that Plot E and its check had larger percentages of loss in the keeping tests than did Plot D and its check. That this was true is also shown by the average counts of decayed berries in samples examined on November 11 given in the following table: —

TABLE V.

	Plot D.	Plot E.	Check D.	Check E.
Number of samples taken,	12	12	12	12
Average counts,	4⅙	7½	7½	9⅓

It might be thought that the difference here noted was due to the earlier picking of Plot E and its check, the greener fruit, perhaps, not keeping as well as that left on the vines until more mature. Close inspection of the results given in Tables II. and III. does not, however, sustain this view. Table III. indicates an improvement in keeping quality for Plot E of about 17⅗ per cent. over the check, while Plot D showed an improvement of only 13⅓ per cent. over its check. This, together with the fact that E gave an increase of 55 per cent. in quantity of fruit over its check while D gave an increase of only 47⅗ per cent., indicates that the greater amount of decay, among the berries from E and its check, in the keeping tests was due to the presence of a greater amount of fungous disease on that portion of the bog. The tests appeared to give no evidence that the stage of ripeness at which the berries were picked had any effect on their keeping quality.

Effect of Resanding on Prevalence of Fungous Disease.

A part of the station bog was resanded in 1911, and most of the remainder in the spring of 1912, with about half an inch of sand. Two Early Black plots (O and V) of 9 square rods each were left unsanded as an experiment, O being located on a portion of the bog sanded in the fall and V on a part sanded in the spring. Checks were laid out on three sides of each of these plots, and in both cases they averaged a distinctly smaller quantity of fruit per square rod in the 1912 crop than did the plots themselves. This difference was perhaps caused by the injury done to the vines in the process of sanding. The keeping qualities of the berries from these plots and their checks were tested with the results given in the following table: —

TABLE VI.

Plot.	Test begun.	Test ended.	Quantity tested (Boxes).	Quantity of Sound Fruit after Screening (Boxes).	Percentage of Loss.
O,	Oct. 3	Dec. 13	1⅔	1 7/17	15 3/10
Check O,	Oct. 3	Dec. 14	2	1 9/16	21 9/10
V,	Oct. 3	Dec. 13	2	1 11/16	15⅗
Check V,	Oct. 3	Dec. 13	2	1⅝	18¾

The same error crept into the measurement of these berries as that noted in connection with Table III. The berries were handled throughout in the same way as were those from the fungus spraying plots. The results seem to indicate that resanding favors fungous diseases.

As a check on the results obtained from the screening, shown in Table VI., the results of examination and counts, given in Table VII., are of interest. These counts were made on November 16. Each number given in Table VII. is the average of the counts of the decayed berries in 6 samples, taken in the same way as with the berries of the fungus spraying plots.

TABLE VII.

	Plot O.	Check O.	Plot V.	Check V.
First average of 6 samples,	6	10½	3½	5½
Second average of 6 samples,	9½	11	2½	10

These results seem to indicate that spring sanding favors fungous development more than does fall sanding. In this respect, the result is the reverse of that obtained from screening.

4. Varieties.

Investigations looking toward the possible production of new and more desirable varieties were continued. The uprights which had been marked on account of their prolificness in 1911 were found in 1912 to be, as a rule, either dead or barren. Only two or three of them bore more berries than the average, and these berries were much below the average in size. Because of the experience with these uprights an attempt was made to discover some of the more certain marks of cranberry prolificness. It now seems that the most noticeable and evident of these marks is the tendency and ability of the uprights of certain varieties to put out new uprights as branches, and at the same time develop from 3 to 5 berries each. A large number of such branching uprights were marked for examination next season. If they do exceptionally well it is planned to use the more prolific ones for planting. It should be noted here that the varieties most grown (Early Blacks, Howes, etc.) seldom produce branches on berry-bearing uprights.

In the fall, for the first time, tests of the comparative keeping qualities of certain varieties were made, and some interesting results were obtained which may eventually be of considerable value.

5. Blossom Fertilization.

The 1911 experiment of shutting out all bees from a small area of vines, during the blooming period and for some time afterwards, was repeated on another part of the bog in 1912. The screen was put in place over this area before a single blossom had opened and kept there until the last part of August.

Strange to say, the enclosed area bore about half as large a crop, per rod, as the surrounding bog. This result appears to contradict partially the results obtained in 1911, and for this reason it is planned to repeat the experiment again in 1913. A few small, solitary bees, or even honey bees or bumblebees, may have worked their way through the netting without being observed and visited a part of the blossoms.

The plot from which bees were excluded in 1911 has in all other respects always been treated like the surrounding bog. It is therefore of special interest to note that in 1912 this plot bore over twice as large a crop per square rod as the average of the rest of the bog, and a considerably larger one than any other equal area on the bog, the fertilizer and fungus plots included. In 1911 this area bore a very light crop in comparison with the rest of the bog. This seems to show that the after effects of light or heavy cropping often appear the following season. It is very desirable to determine to what extent this is true, for if it can be established that such effects generally do appear in the crop of the succeeding season, it must have a strong bearing on the management of cranberry bogs in more than one respect. If these effects are carried over, the apparent importance of keeping bees to insure good blossom fertilization is, in general, much reduced, for what a bog fails to produce in years of bee scarcity, on account of poor fertilization, it will tend to make up in years of bee abundance.

The keeping quality of the berries from this 1911 plot was tested, in comparison with the berries from some of the fertilizer plots. The results of the test were as follows: —

TABLE VIII.

Plot.	Test begun.	Test ended.	Quantity tested (Boxes).	Quantity of Sound Fruit after Screening (Boxes).	Percentage of Loss.
1911 Bee Exclusion Plot, ...	Oct. 11	Dec. 16	$\frac{1}{3}$	$\frac{26}{96}$	$18\frac{3}{4}$
Fertilizer Plot 22, ...	Oct. 11	Dec. 14	2	$1\frac{7}{16}$	$28\frac{1}{8}$
Fertilizer Plot 21, ...	Oct. 11	Dec. 14	2	$1\frac{3}{8}$	$31\frac{1}{4}$
Fertilizer Plot 20, ...	Oct. 11	Dec. 16	2	$1\frac{1}{2}$	25
Fertilizer Plot 1, ...	Oct. 11	Dec. 14	$1\frac{1}{3}$	$\frac{7}{8}$	$34\frac{2}{5}$
Fertilizer Plot 2, ...	Oct. 11	Dec. 14	2	$1\frac{13}{32}$	$29\frac{7}{10}$

These fertilizer plots were located near the bee plot and are here arranged in their order of proximity to that plot, 22 being the nearest and 2 the farthest away. Plot 22 is separated from the bee plot by not more than its own width, and 2 is not more than 8 rods away. Plots 1, 21 and 22 are all check fertilizer plots, and have been treated in all respects like the surrounding bog. The results indicate that the bee plot berries for some reason were much better keepers than were the berries of the surrounding bog.

The average counts of decayed berries in several samples taken from each of these plots give evidence of the general accuracy of the results shown in the above table. They were as follows: —

TABLE IX.

	1911 Bee Plot.	Fertilizer Plot 22.	Fertilizer Plot 21.	Fertilizer Plot 20.	Fertilizer Plot 1.	Fertilizer Plot 2.
Number of samples taken,	4	8	8	8	8	8
Average counts,	8	16	18½	10½	20	14½

These counts were made between the 14th and the 22d of November.

The comparatively small percentage of loss among the bee plot berries shown in Table VIII. is surprising, in view of the fact that for some reason there was evidently a greater loss caused by the collapse of berries injured by fruit worms in this lot than in those from the fertilizer plots. In general, these results may perhaps be taken to indicate that the berries of a heavy cranberry crop will, other conditions being the same, keep better than those of a light

The berries from this bee plot showed other peculiarities as follows: —

First. — A marked comparative softness resembling the softness often characteristic of russet apples in the spring due to loss of water during long storage. This was so evident that the screeners noticed it at once on changing from other berries.

Second. — A large proportion of berries with rough areas on them, somewhat resembling the russeting of apples. These

areas are peculiar to berries of the Early Black variety, being only occasionally found on Howes and McFarlins. Counts of berries having such areas in samples taken from different plots and varieties are given in the following table, as knowledge concerning this may have value: —

TABLE X.

Plot.	Variety.	Number of Samples taken.	Berries with Rough Areas.	Berries without Rough Areas.
1911 Bee Exclusion Plot,	Early Black,	3	49	68
			58	60
			55	56
Fertilizer Plot 22,	Early Black,	2	26	73
			30	81
Fertilizer Plot 15,	Early Black,	3	14	86
			13	78
			11	79
Plot B,	McFarlin,	1	4	66
Check B,	McFarlin,	1	7	72
Plot C,	Howe,	1	6	89
Check C,	Howe,	1	9	96
Plot D,	Early Black,	2	27	77
			33	70
Check D,	Early Black,	2	31	67
			28	78
Plot E,	Early Black,	1	18	90
Check E,	Early Black,	1	20	101

Note the much larger proportion of rough berries from the bee plot as compared with those from any of the other plots. Note also the much smaller proportion of such berries produced by fertilizer Plot 15 as compared with the other Early Black plots. Plot 15 was treated in 1911, and again in 1912, with 200 pounds of nitrate of soda, 400 pounds of acid phosphate and 200 pounds of high-grade sulfate of potash. Plot 22 was a check plot without fertilizer. Plots B, C, D and E were the sprayed fungus plots already discussed. The fact that the fruit from D and E was practically the same in this respect as that from their checks tends to indicate that the roughness was not

caused by fungous disease. In the opinion of the writer it was caused (as is the russeting of apples) by the deposition of corky tissue in the skin of the fruit. Dr. Shear, in examining berries with these rough areas, found no fungus in connection with them. The difference, shown in Table X., between Plots D and E was probably due to the difference in the time of picking the berries.

These rough areas are usually more abundant among berries grown on "hard bottom" than among those grown on peat. Berries grown on "hard bottom" are usually, other conditions being the same, better keepers. This well-known fact, together with the experience with the berries from the bee plot here noted, suggests that the roughening of the fruit here discussed may be relied upon to some extent as an indicator of the keeping quality of Early Black berries. The fruit of the Late Howe variety is sometimes streaked with irregular, vein-like, red lines during ripening, and these lines appear to be of the same nature as the rough areas on the Early Black fruit, for they are most prevalent, as a rule, on berries grown on "hard bottom," and occasionally rough areas are associated with them, the roughness being superficial while the red veining is deeper within the tissues.

6. Fertilizers.

The Waquoit experiments were not continued, though the plots were examined just before harvesting and were found without exception to have produced a very light crop. There was apparently no evidence of any cropping effect from the fertilizers used in the preceding seasons.

The plots on the station bog at East Wareham were fertilized again, with the results shown in Table XI. The fertilizers were applied on June 25 and 26. The berries were all picked with scoops on September 11 and 12. They appeared so uniform in color and so alike in most other respects that no records were made, except those concerning their quantity, size and keeping quality. Storage tests were carried out with berries from all the plots, beginning October 11 and ending December 13 to 17, the results of which gave no evidence that any of the fertilizers, except perhaps the acid phosphate, had af-

fected the keeping quality in any way whatever. There seemed to be somewhat less loss, as a rule, among the berries from the plots treated with phosphate (alone or in combination) than among those from the plots on either side of those so treated. The results in this connection, however, were not very positive.

TABLE XI.

PLOT.	Fertilizer used.	Quantity of Fruit obtained (Boxes).	Size of Berries; Average Number in 8 Samples.
1,	-	1⅞	109
2,	N	3¼	108
3,	P	2	105½
4,	K	1¾	112
5,	-	1¾	105½
6,	NP	3 1/7	108½
7,	NK	3⅞	102
8,	PK	2¾	106½
9,	-	2⅓	110
10,	NPK	4	104
11,	NPKL	3½	105½
12,	NPKcl	3⅖	99
13,	-	2½	108½
14,	$N_{1\ 1/2}$ PK	4⅚	105
15,	N_2 PK	6 1/9	102½
16,	$NKP_{1\ 1/2}$	5⅔	103½
17,	-	3⅙	106½
18,	NKP_2	5½	102
19,	$NPK_{1\ 1/2}$	4	106½
20,	NPK_2	4⅕	103½
21,	-	3	105½
22,	-	3⅛	106
23,	-	2	106

Plots 1, 5, 9, 13, 17, 21, 22 and 23 are all untreated check plots. The meanings of the fertilizer symbols used are as follows: —

N means 100 pounds nitrate of soda per acre.
P means 400 pounds acid phosphate per acre.
K means 200 pounds high-grade sulfate of potash per acre.

L means 1 ton of lime (slaked) per acre.
KCl means 200 pounds muriate of potash per acre.
$N_{1\ 1/2}$ means 150 pounds nitrate of soda per acre.
N_2 means 200 pounds nitrate of soda per acre.

In combinations they mean, for example, as follows: N_2PK = 200 pounds of nitrate of soda + 400 pounds of acid phosphate + 200 pounds of high-grade sulfate of potash per acre.

The nitrate of soda evidently had a marked effect in increasing the quantity of fruit. As is shown by the figures in column four of Table XI. (the average sizes of the berries were inversely proportional to these figures), the variation in size between the berries from the different plots was not very great. The increases in quantity were evidently due for the most part to an increase in the number of the berries, the increase in their size being a minor factor. The potash caused no increase in fruit and the phosphate but very little. If the lime had any effect, it was detrimental. The boxes used in measuring this fruit were bushel boxes. The area of each of these plots is 8 square rods.

While the vines showed more growth on the plots to which the nitrate was applied than on the rest of the bog, this growth was not more than is desirable. There seem to be indications that the degree of drainage during the growing season has an influence on the action of nitrogenous fertilizers in their effects on fruit production and vine growth.

7. Insects.

The total cranberry insect injury of 1912 was greater than is usual on Cape Cod. The damage done by the fruit worm was more than in any season for four or five years before. The blackhead cranberry worm (fireworm) did greater and more general injury than in any season before for many years. The span worm caused serious injury for the first time in several years, destroying the crop and all the foliage on the greater part of the Old Colony bog at Yarmouth. The scale insect (*Aspidiotus oxycoccus* Woglum), discussed in last year's report as having done serious injury on a bog in Yarmouth, disappeared almost entirely, having been destroyed, apparently, by the winter flowage. It now seems evident that winter flowage

is sufficiently detrimental to this pest to control it entirely, without any other treatment, if it is applied regularly every year and is held until May. The insect got its foothold on the Yarmouth bog in a season following a winter during which the bog was not flowed.

By correspondence the writer learned of serious injury on some Long Island bogs due, apparently, to the work of spittle insects, though it seems probable that other causes may have been contributory. The experience of the managers of these bogs indicates that complete reflowing for a day or two, when these insects are at work, will drive them out satisfactorily, and also that contact poisons may be used against them with considerable success where water for flowage is not available.

That the gypsy moth was abundant on bogs in places, especially in North Carver, was shown by the specimens sent in for determination.

The experimental insect work was confined mostly to the fruit worm and the blackhead cranberry worm (fireworm), though observations on the girdler (" root worm ") were also made.

The Fruit Worm (*Mineola vaccinii* (Riley)).

Investigations concerning the effect of weather conditions at different seasons on fruit worm abundance were started, and the results of this work indicate the possibility of forecasting seasons in which great injury may be expected from this insect.

Late holding of the winter flowage is the surest method of controlling this insect so far known. The year's observations indicate that it is probably best to hold this flowage late (until May 25) every other year instead of every third or fourth year, as has been heretofore recommended. This is certainly true, if the effects of light and heavy cropping are generally carried over from one season into the next, as indicated by the results obtained on the 1911 bee experiment plot, for the reduction in the crop of one season, caused by the late holding of the water, will be largely made up the following year. This treatment is sure to greatly reduce the fruit-worm injury for the years of early withdrawal as well as for the years of late holding. Moreover, it seems probable that much of the fruit reduction, caused by ordinary late holding of the winter flowage, is really

due to increased fungous injury, which might be largely prevented by proper spraying.

Early putting on of the winter flowage does not appear to affect the fruit worm much. A 10-acre bog, which lost most of its crop by this insect in 1911, was flowed for the winter on October 5, and the flowage was not let off until May 8. Even after this long flooding the fruit worms destroyed about 50 per cent. of what would otherwise have been a good crop.

Spraying, as a fruit-worm remedy, is still of doubtful practicability and probably always will be. The need of such a treatment, however, is not very great, for, as already stated, this insect can be treated with water where winter flowage is available, and the total acreage of bearing bog which cannot be winter-flowed at a reasonable expense is a very small percentage of the total bog area of the Cape. Moreover, most bogs which cannot be winter-flowed at a reasonable pumping expense are not and never were good business propositions for various reasons, and should never have been built in the first place. However, as there are a few such bogs which will pay a moderate return if the fruit worm is kept within bounds, it seems desirable if possible to find some treatment other than winter flowage for this insect.

A patch of 9 square rods on a dry bog badly infested with this insect was resanded on May 23 to a depth of 1 inch, the uprights being raked up through the sand when covered by it. It was thought that such sanding, while the insect was dormant in its winter cocoon, might smother it, as it does the girdler, so that the millers would not emerge during the following summer to lay eggs for another brood of worms. The sanded area was surrounded with a mosquito netting fence 8 feet high to keep the moths from the surrounding bog from coming onto it; but it was not closed in at the top, as it was necessary to give bees free access to the blossoms inside, and the moths, which apparently never fly up more than 5 or 6 feet from the ground, would probably not get in over the fence. Unfortunately, the new growth had started considerably when the sanding was done and, on this account, the injury to the buds was very severe, more than three-fourths of them being destroyed. Earlier sanding would have caused less injury. This experiment was only par-

tially successful, as numerous fruit worm millers were seen inside the netting during the season, and probably 40 per cent. of the berries that developed on the sanded area were destroyed by the worms. That a large percentage of the millers was smothered is shown by the fact that at picking time there were noticeably more berries on the sanded area than on any equal area of the surrounding bog, in spite of the great injury done to the buds in the process of sanding. The amount of infestation on the bog where the sanding was done is shown in a general way by the fact that on a large part of the bog the worms destroyed all the berries after there had been a blossom and a fruit setting which should have produced not less than 60 barrels to the acre. As it seems probable that this sanding will also have some effect on next year's infestation, the experiment will be continued the coming season.

As strictly dry bogs are usually either winter-killed or badly spring-frosted about every two or three years, it seems probable that the best treatment for this insect on such bogs would be to destroy the remnant of the crop in the years when the severe injury from either frost or winter-kill occurs. This could probably be most readily done by spraying the bloom with a 20 per cent. solution of iron sulfate. The destruction of the bloom would cut off the season's local food supply for the insect, and it would naturally, for the most part, die off by starvation as a result. In most cases, this destruction of the bloom, after its severe reduction by adverse weather conditions, will not result in a loss to the grower, for, if the blossoms are left and the crop remnant is allowed to develop normally, the fruit worms, which without the interference of weather conditions would have an ample food supply, will be compelled to concentrate on the remnant, with the result that there will be little or nothing left at picking time anyway.

During the season following one in which a bog's infestation is starved out in this way, practically the only infestation present will be that which comes in from the upland, and that will probably not be very serious in most cases.

Another probable benefit from this method of treatment is that coming from not tearing up the vines in picking what little fruit might be left after the worms got through if the

remnant of the bloom was not destroyed. *Probably more is lost, as a rule, through injury done to the vines, in harvesting a very light crop, than is gained by saving and marketing the berries.*

Work on fruit-worm parasites was continued, but without any definite results of general value.

The Flowed Bog Fireworm (*Rhopobota vacciniana* (Pack.)).

This insect is also known as the blackhead cranberry worm, but it will probably be more readily and generally recognized by the more distinctive name here used. It does little or no damage on bogs that are not winter-flowed. As indicated in the 1911 report, the killing or driving ashore of the natural enemies of this insect by the flowage is probably the main cause of serious infestation by it. In support of the evidence given in that report, the results of this season's collecting of bog insects seem rather convincing. Collections were made on several winter-flowed bogs of great difference in area, at different lengths of time after flooding and at different distances from the uplands, for comparison. Each collection consisted of the material gathered by 100 sweeps of a collector's net through the vines. Three separate collections were made on each day of collecting at each location selected for comparison, to make sure that the collections were truly representative of the insect life present. Comparisons between the different locations were made by separating out the parasitic and predacious forms, classifying them, counting the individuals of each class in each collection separately, and comparing the counts. The most remarkable fact learned from this was that, of all forms capable of damaging the fireworm, spiders were in all cases considerably the most numerous. Moreover, only the spiders gave really striking differences in the counts of the different collections made. The comparisons showed that the dry bog had very many more spiders and also a somewhat larger number of parasitic insects than did any of the winter-flowed bogs, even as late in the season as August 20, when the last collecting was done. A bog of 160 acres of rounded shape gave a distinctly smaller count of spiders, on all parts examined twenty-seven days after the flowage was taken off, than did a bog of 12 acres of similar

shape on its very central portion sixty-eight days after the removal of the flowage. The distance from the center of the 12-acre bog to the upland at the nearest point is about 250 feet, as roughly measured by pacing. The 160-acre bog, in the material collected twenty-seven days after the flowage was taken off, gave distinctly larger counts and showed a greater variety of spiders near the upland than at the center. At the same time some kinds of parasitic insects were collected near the upland which seemed to be entirely absent at the middle of the bog. The distance from the center of this bog to the upland at the nearest point is about 750 feet, as measured by pacing.

While it is evident, therefore, that winter flowage seriously reduces the work of the natural enemies of the fireworm, especially on the large bogs, it must be remembered that in spite of this handicap they succeed in doing a great deal toward controlling this insect on all bogs and that, in the first beginnings of the most damaging infestation, only a few stragglers here and there succeed in escaping them. The escape of these stragglers is, however, a serious matter, for they increase the amount of infestation which these natural enemies must take care of the following season (a slight infestation probably coming onto the bog from the upland every year) if they succeed in keeping the pest under control. As the winter flowage comes in and sweeps away these natural enemies again, they cannot increase on the bog to meet the increase in the number of fireworms. The fireworms, therefore, tend to increase in number, while the number of their enemies tends to remain constant from season to season on account of the flowage interference (the bog is here considered as being winter-flowed, but not reflowed at a time to reduce the fireworms). When once the infestation has developed beyond the ability of the natural enemies of the insect to control it, its increase is very rapid unless artificial aids to these enemies are provided by man. Theoretically, the escape of 2 straggler fireworms one year may mean the escape of perhaps 50 the next year, and of perhaps 1,200 the third year, and of 30,000 the fourth year, and so on.

The point toward which we have been working in this discussion is this: *probably the ideal time to spray for this insect with arsenical poisons,* especially on the large compact bogs and on

bogs which cannot be reflowed in June after having been winter-flowed, *is not after an infestation has fully developed and so threatens vines and crop that something must be done at once, but is before the infestation starts.* Cutting off the stragglers by spraying at the proper time every year, whether the insect appears to be present or not, will greatly retard the development of an infestation, if it does not completely stop it. Spraying for the stragglers need not be as effective as it would have to be under conditions of bad infestation, because the natural enemies of the fireworm will take care of most, if not all, of the worms which escape the poison. Unless the work of spraying for a heavy infestation is extraordinarily thorough and effective, there will be left, at best, a far greater number of unharmed worms than their natural enemies can begin to cope with.

Some will probably object to this method of treatment on the ground of expense. This, however, does not seem to be a valid objection when we consider that the prevention of the loss of a single average crop will make up for the expense of four good sprayings each year for a period of ten years. Then, too, as our spraying experiments, discussed in this report, have shown, most bogs should probably be sprayed several times each year to control fungous diseases. The fireworm spraying may be done at the same time, by using an excess of lime in making the Bordeaux mixture and adding a pound of Paris green to every 50 gallons, at an additional annual expense of perhaps $3.50 per acre.

While the prevention of infestation by this insect is important, it is necessary to consider how a fully developed infestation may be most easily cleaned out. As indicated in last year's report, the most serious obstacle usually encountered in ridding a bog of a bad infestation is the length of the hatching period, especially of the eggs that produce the first brood. This period seems to be much prolonged on bogs with thick vines, probably because the vines so shade the eggs on the lower leaves that their development is much slower than that of the eggs which, placed on the tops of the vines, are more exposed to the sun. In extreme cases, which are not uncommon, the hatching period is so much prolonged that there seems to be no time during the year when eggs of either the first or the second brood are not

present in considerable numbers. When this period is not too much prolonged, it is often possible, at least on small bogs, to control a heavy infestation fairly well with either a single good spraying or a single early June reflowing.

The most successful treatment with water, all conditions considered, which the writer knows of, was applied on one of the large bogs during this season. The winter flowage was held until the 2d of June, from which date the bog was without flowage or any special treatment until the 25th of the same month, when it was completely reflowed for two days. Before this reflow the bog was heavily infested, but after it only a very few fireworms were seen throughout the season. This bog is compact in shape and covers about 160 acres. A considerable portion of it is heavily vined, and the infestation was spread pretty well over it. The most reasonable explanation of the success of this treatment appears to be the following one: —

In the water of the winter-flowage there was perhaps not so great a difference in temperature between the tops and the bottoms of the vines, especially where they were thick, as there would have been had they been exposed to the air as well as to the sun. Under these conditions all the fireworm eggs present were perhaps influenced in their development much more equally by the rising temperature of the spring days than they would have been without the flowage. The eggs were probably thus brought nearly to the hatching condition fairly well together, and then the water was taken off so that in this condition they were at once exposed to the hot weather of June, which naturally hastened rapidly the remaining development of all of them. By this means the hatching was so bunched up that when the bog was reflowed twenty-three days after the winter flowage was let off practically all the eggs, on thick vines as well as on thin ones, had hatched, and the insects were almost entirely in the caterpillar (worm) stage, the stage in which they are most readily drowned.

Possibly this method of treatment will not always prove as successful as it did in this case, but the conditions attending this trial were such that the results should probably be considered significant. This method should be tried further where badly infested bogs can be reflowed in June. Moreover, if the

reasons given above for the success of this treatment are correct, it seems probable that spraying for a heavy infestation of this insect would be most successful if it were done after first bunching the hatching of the eggs by holding the winter flowage late. If the water is held late, the first spraying should be all done within a week after the flowage is taken off.

There is little doubt that any bog can be freed from this pest by treating it as a strictly dry bog for a few years (*i.e.*, not flooding it at any time under any conditions), thus allowing the natural enemies of the insect to accumulate against it, and at the same time spraying at proper times with arsenical poisons. The danger of loss from winter-kill and from fruit-worm infestation is, however, considerable under such conditions and must not be overlooked.

Small bogs can probably be rid of infestation by thorough spraying without omitting winter flooding.

The season's observations indicate that spiders (of several different species) and Tachina flies are the most numerous and useful of the natural enemies of the fireworm. Spiders attack and destroy the worms, and some of the jumping species have been seen to leap into the air after the millers. The Tachina flies lay the white eggs often seen on the worms, especially on and near their heads.

The Cranberry Girdler (*Crambus hortuellus* (Hübner)).

The season's observations on this insect sustain in every particular the conclusions concerning it reached in the past two years. A serious infestation by this insect, at least on a bog of small or medium size, is almost a certain sign of neglect. It apparently never succeeds in getting a foothold on bogs which are kept well sanded. Resanding every other year is usually sufficient to prevent infestation by it. Badly infested bogs almost invariably have an accumulation of old leaves over the sand under the vines, and usually the worst infestations are on heavily vined bogs.

There are indications that the girdler is often favored by man's flooding operations in the same way that the flowed bog fireworm is favored, — *i.e.*, by the destruction or driving ashore of its natural enemies. Winter-flowed bogs which cannot be

reflowed appear to be more often seriously infested than do strictly dry bogs. It seems probable that neglect invites infestation by this insect because of the protection from its natural enemies afforded by the accumulation of dead leaves and other débris. Resanding covers up this material and probably compels the girdler worms to work under more exposed conditions.

Reflowing for a week or ten days right after picking is still a standard remedy for this insect where sufficient water is available.

8. Miscellaneous.

In addition to the work already discussed, sanding and picking experiments have been started. In the former, the results of no resanding are being compared with those of resanding every year, every other year and once in three years. In the picking experiments hand picking is being compared with scoop picking and early picking with late picking, in their effects on the vines and on crop production. These experiments must be carried on for several years before very definite results from them can be reported.

Experiments to determine the effects of different weather conditions on the "setting" of the fruit were also started. A general weather record was begun with the idea of ascertaining the effects of different weather conditions at different seasons on cranberry growth, fruit production, insect enemies and fungous diseases.

INDEX.

INDEX.